SCHOOL OF MINES AND METALLURGY

University of Missouri

CATALOGUE
1906-1907

ROLLA, MISSOURI

INTERNATIONAL CLUB—MISSOURI SCHOOL OF MINES AND METALLURGY
ROLLA, MISSOURI

First row kneeling, beginning at left: Espriu, Mexico; Valencia, Mexico; Boza, Peru; Garza, Mexico; Garcia, Mexico. Second row: Garza, Mexico; Garcia, Mexico; Diaz, Chili; Swenson Mexico; Talwar, India; Elicano, P. I.; Diaz, Chili; Mapes, Mexico; Cavazos, Mexico. Third Row: Jones, Mexico; Seamon, Mexico; Palomares, Mexico; Shah, Russia; Raj, India.

THIRTY-SIXTH ANNUAL CATALOGUE

OF THE

School of Mines and Metallurgy

A DEPARTMENT OF THE

UNIVERSITY OF MISSOURI,

ROLLA, MO.

1907

Calendar for 1907 and 1908

1907

APRIL.

S	M	T	W	T	F	S
..	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	..	..	..	..
..	..	..	..	..	..	..

JULY.

S	M	T	W	T	F	S
..	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	..	..	..
..	..	..	..	..	..	..

OCTOBER.

S	M	T	W	T	F	S
..	..	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	..	..
..	..	..	..	..	..	..

MAY.

S	M	T	W	T	F	S
..	..	..	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	..
..	..	..	..	..	..	..

AUGUST.

S	M	T	W	T	F	S
..	..	..	..	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
..	..	..	..	..	..	..

NOVEMBER.

S	M	T	W	T	F	S
..	..	..	..	..	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
..	..	..	..	..	..	..

JUNE.

S	M	T	W	T	F	S
..	..	..	..	..	..	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	..	..	..	..	..	..

SEPTEMBER.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	..	..	..	..	..
..	..	..	..	..	..	..

DECEMBER.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	..	..	..	..
..	..	..	..	..	..	..

1908

JANUARY.

S	M	T	W	T	F	S
..	..	..	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	..
..	..	..	..	..	..	..

MARCH.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	..	..	..	..
..	..	..	..	..	..	..

MAY.

S	M	T	W	T	F	S
..	..	..	..	..	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	..	..	..	..	..	..

FEBRUARY.

S	M	T	W	T	F	S
..	..	..	..	..	..	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
..	..	..	..	..	..	..

APRIL.

S	M	T	W	T	F	S
..	..	..	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	..	..
..	..	..	..	..	..	..

JUNE.

S	M	T	W	T	F	S
..	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	..	..	..	..
..	..	..	..	..	..	..

DIRECTOR'S RESIDENCE.

VIEW ON CAMPUS.

CALENDAR.

1907.

June 8, Saturday, 10 a. m. ..... Annual Commencement.
May 31 to June 6, inclusive ..... Final Examinations.
September 14 and 16, Saturday and Monday ..... } Entrance Examinations.
September 17, Tuesday ..... First Term Begins.
November 28, Thursday ..... Thanksgiving Holiday.
December 20, Friday 12 m ..... Christmas Recess Begins.

1908.

January 2, Thursday ..... Second Term Begins.
February 22, Saturday ..... Holiday.
March 16, Monday ..... Third Term Begins.
May 29 to June 4, inclusive ..... Final Examinations.
June 10, Wednesday ..... Annual Commencement.

BOARD OF CURATORS.

To January 1, 1907.

GARDINER LATHROP,	Kansas City.
B. G. THURMAN,	Lamar.
A. MCVEY,	Chillicothe.

To January 1, 1909.

D. R. FRANCIS,	St. Louis.
H. C. WELLS,	Platte City.
C. B. FARIS,	Caruthersville.

To January 1, 1911.

WALTER WILLIAMS,	Columbia.
B. H. BONFOEY,	Unionville.
J. C. PARRISH,	Vandalia.

OFFICERS OF THE BOARD.

GARDINER LATHROP,	President.
C. B. FARIS,	Vice-President.
J. G. BABB,	Secretary.
R. B. PRICE,	Treasurer.

VIEW ON CAMPUS.

EXECUTIVE COMMITTEE

OF THE

SCHOOL OF MINES AND METALLURGY.

B. G. THURMAN, ... Lamar.
C. B. FARIS, ... Caruthersville.
J. C. PARRISH, ... Vandalia.

OFFICERS OF THE COMMITTEE.

C. B. FARIS, ... Chairman.
CHARLES L. WOODS, ... Secretary.
HENRY WOOD, ... Treasurer.

Director of the School,
GEORGE E. LADD.

Secretary of the Faculty,
JOHN B. SCOTT.

Librarian,
JESSIE HELLER,

Superintendent of Grounds and Bldgs.
ROBERT DICKERSON.

VIEW ON CAMPUS.

FACULTY.

RICHARD HENRY JESSE, LL. D., *President of the University.*

GEORGE EDGAR LADD, PH. D. { *Director and Professor of Geology and Mining.*
A. B. 1887, A. M. 1888, Ph. D. 1894, Harvard University.

GEORGE REGINALD DEAN, C. E., . *Professor of Mathematics.*
C. E. 1890, B. S. 1891, School of Mines.

AUSTIN LEE MCRAE, S. D. . . . . *Professor of Physics.*
B. S. University of Georgia, 1881.
S. D. Harvard University, 1886.

VICTOR HUGO GOTTSCHALK, M. S. . *Professor of Chemistry.*
B. S. 1898, M. S. 1900, School of Mines.

ELMO GOLIGHTLY HARRIS, C. E. . . . { *Professor of Civil Engineering.*
C. E. 1882, University of Virginia.

JAMES CLARK DRAPER, E. M. . { *Professor of Mining Engineering.*
B. S. 1901, E. M. 1903, School of Mines.

GEORGE ARTHUR PACKARD, S. B., { *Acting Professor of Metallurgy.*
S. B. 1890, Massachusetts Institution of Technology.

LEON STACY GRISWOLD, A. B. { *Assistant Professor of Geology and Mineralogy.*
B. S. 1889, Harvard University.

JOSEPH HENRY BOWEN. . . { *Assistant Professor of Shop Work and Drawing.*
Graduate Miller School, Va.

LEON ELLIS GARRETT, B. S. . . . { *Assistant Professor of Mathematics.*
B. S. 1901, School of Mines.

FACULTY—CONTINUED.

ROBERT CLAIR THOMPSON, M. S., . { *Assistant Professor of Chemistry.*
B. S. 1900, Westminster College, Pa.
M. S. 1904, School of Mines.

PAUL JULIUS WILKINS, B. S. . . { *Instructor in Modern Languages.*
B. S. 1869, Michigan A. & M. College.

JOHN BENNETT SCOTT, . *Instructor in English and Secretary.*

ELWYN LORENZO CLARKE, B. S., . . { *Instructor in Civil Engineering.*
B. S. in C. E. 1902, University of Illinois.

EDWARD STAPLES SMITH, M. E., . . *Instructor in Drawing.*
M. E. 1904, Brown University.

ALBERT BABBITT BARTLETT, . . . *Assistant in Surveying.*

FRANK LEWIS LEONARD WILSON,. . *Assistant in Mineralogy.*

ANDREW JACKSON SELTZER, . . . *Assistant in Metallurgy.*

HORACE THARP MANN, . *Assistant in Chemical Laboratory.*

ELDON EVERETT COOK, . *Assistant in Physical Laboratory.*

EDWIN RICHARD WASH, ... *Assistant in Assaying.*

WILLIAM CLUTCHER PERKINS, . . *Assistant in Surveying.*

IRA LEE WRIGHT, ... *Assistant Surveying.*

CLYDE REX WOOD, ... *Assistant Drawing.*

EDWARD PHILLIP BARRETT, *Assistant in Chemical Laboratory.*

THOMAS GRANT COOKE, . *Assistant in Chemical Laboratory.*

VIEW ON CAMPUS.

HISTORY.

In 1870 the General Assembly of Missouri, in accepting the donation of land for educational purposes made by the General Government through Act of Congress, approved July 2, 1862, established an Agricultural and Mechanical College and a School of Mines and Metallurgy. The design of these institutions is set forth in the following language:

OBJECTS OF THE COLLEGES.—The leading objects of said colleges shall be to teach such branches as are related to agriculture and the mechanic arts and mining, including military tactics, and without excluding other scientific and classical studies, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life. (R. S. 1899, Sec. 10504-10521.)

The *School of Mines and Metallurgy* was located at Rolla, Phelps County. Here, in November, 1871, the school was formally opened.

The statutes fix the *status* of the School as one of the *Colleges* of the State University. Its affairs are under the immediate supervision of an Executive Committee, consisting of three members of the University Board of Curators, selected by that body.

The need of general culture as a foundation and accompaniment of specifically technical training, led to the establishment, in 1885, of an Academic Course in compliance with the following Act of the General Assembly:

ACADEMIC COURSE OF STUDY, ETC.—That the obligations of the State to the General Government, assumed by the acceptance of the land grant of July 2, 1862, may be more fully discharged, and in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life, the Board of Curators of the State University shall prescribe and adopt a liberal Academic Course of Study to be taught in the College of Mines and Metallurgy, located at Rolla, in addition to the courses now taught in said

school, and may confer the degree of Bachelor of Science upon all students who shall complete said course in said school to the satisfaction of the faculty thereof. (R. S., Sec. 10504-10521.)

The School of Mines is organized and conducted with a view to subserving, as efficiently as possible, the ends set forth in the legislative enactments in reference to it.

FINANCES.

The proceeds from the sale of the public lands granted by the General Government amount to about $350,000, which is invested in State certificates of indebtedness bearing 5 per cent interest. The School of Mines receives one-fourth of the yearly income thus accruing.

By an Act of Congress, approved August 30th, 1890, commonly known as the "Morrill Bill," the General Government donated to each State and Territory maintaining a college or colleges in accordance with the act of July 2d, 1862, $25,000 a year. After deducting one-sixteenth of this fund for the Lincoln Institute, Missouri gives one-fourth of the remainder to the School of Mines.

In 1891, the Government returned to the various States the sums collected from their citizens by the imposition during the Civil War of a "direct tax." The amount thus refunded to Missouri was $646,958.23, and the 36th General Assembly of the State won the gratitude of the friends of higher education by establishing this as a permanent endowment for the State University at Columbia and the School of Mines and Metallurgy at Rolla. One-fifth of the income from this endowment, amounting to $6,469.58 per annum, is received by the School of Mines.

The Fortieth General Assembly of the State passed an act providing for a tax on collateral inheritances for the benefit of the State University, and the Forty-first General Assembly has provided that one-fifth of the funds derived from this tax shall be appropriated for the benefit of the School of Mines.

ENDOWMENT.

The State endowment of the School of Mines is set forth in the following extracts from the Statutes of Missouri:

"The proceeds of the sale of lands donated to the State of Missouri by the United States for the support of the college of agriculture and mechanic arts and the School of Mines and Metallurgy, by act of Congress, approved July 2, 1863, represented by State certificates of indebtedness, of the following amounts and dates:

July 2, 1883	$242,000.00
November 1, 1883	5,000.00
January 29, 1884	5,000.00
April 19, 1884	35,000.00
April 2, 1885	5,000.00
February 25, 1886	5,000.00
January 1, 1888	5,000.00
December 15, 1888	5,000.00
May 15, 1889	5,000.00
July 1, 1891	5,000.00
May 15, 1893	5,000.00
July 1, 1895	22,881.19
April 9, 1895	5,000.00
Representing a total of	$349,881.19

Now issued or any certificates which may hereafter be issued under any general or special act of the General Assembly; one-fourth of the interest of these funds shall be paid to the Treasurer of the School of Mines and Metallurgy, at Rolla, for the maintenance of said institution."

"The proceeds of sales of lands donated to the School of Mines and Metallurgy at Rolla, represented by the State certificate of indebtedness of $2,000, dated April 15, 1893, issued under act March 31, 1883, interest on which shall be applied to the maintenance of the School of Mines and Metallurgy at Rolla."

"The State certificate of indebtedness of $3,000, issued under act of April 1, 1895 (pages 278 and 281, Laws 1895) dated April 1, 1896, four-fifths of the interest to be applied to the maintenance of the State University at Columbia and one-fifth to the School of Mines and Metallurgy at Rolla, and also any other certificates which may hereafter be issued and held in trust for this fund under any general or special act of the General Assembly." (R. S. 1899, Sec. 10522.)

"The State certificate of indebtedness of $646,958.23, derived from 'direct tax' received from the United States, dated April 1, 1891, issued under act of March 26, 1891, four-fifths of the interest to be applied for

the maintenance of the State University at Columbia, and one-fifth for the School of Mines and Metallurgy at Rolla." (R. S. 1899, Sec. 10522.)

"All sums collected under the provisions of An Act of Congress approved August 30th, 1890, commonly known as the "Morrill Bill" shall be paid as follows: One-sixteenth thereof for the benefit of the Lincoln Institute and one-fourth of the remainder to the Treasurer of the School of Mines at Rolla, Missouri." (R. S. 1899, Sec. 10533.)

Collateral Inheritance Tax.—"The moneys received by the State Treasurer under the provisions of this article shall be deposited in the State treasury to the credit of the fund now existing in the State treasury, and known as the "State Seminary Moneys", for the maintenance, support and better equipment of the buildings, apparatus, books, instruction, etc., of the University of the State of Missouri, to an amount not exceeding in any one year the equivalent of one-tenth of one mill for every dollar of the assessed valuation of taxable property of the State for the said year: *Provided,* that one-fifth of all such moneys so received shall be devoted to the use of the School of Mines and Metallurgy, a department of the said University." (Session Acts 1901. Section 302.)

LOCATION.

The School of Mines is situated at Rolla, the county seat of Phelps County, on the St. Louis & San Francisco R R., approximately half way between St. Louis and Springfield.

Rolla is on the crest of the Ozark uplift. It has an elevation of 1,140 feet above the sea level, and enjoys an agreeable and notably healthful climate. Its position on a great transcontinental railway system renders it readily accessible from all quarters. It is within easy reach of the lead and zinc districts of the southwest, and of the lead and iron region of the southeast, while opportunities to observe processes of mining and smelting the latter ores are close at hand. The numerous and varied smelting and chemical plants in and about St. Louis likewise offer good opportunities for the study of processes.

VIEW ON CAMPUS.

CAMPUS AND ATHLETIC FIELD.

The grounds of the School of Mines are situated in the highest part of the City of Rolla, and are over twenty-seven acres in extent. The relative location of the buildings on the grounds is shown on the accompanying diagram.

The campus contains beautiful lawns, groves of native oak, and is adorned and surrounded by hundreds of ornamental shade trees.

The athletic field has a good baseball diamond, a foot ball gridiron, tennis courts, a two hundred and twenty yard oval running track and a 200 yard stretch for sprints and hurdles.

BUILDINGS AND EQUIPMENT.

There are ten buildings located on the enclosed campus:

Mining and Metallurgical Building.
Chemical Laboratory.
Museum and Geological Survey.
Workshop.
Temporary Building.
Director's Residence.
Mechanical Building.
Norwood Hall, Engineering Building.
Heating and Power Plant.
Ore Dressing Laboratory.

MINING AND METALLURGICAL BUILDING.

The special building for the Department of Mining and Metallurgy, finished in 1895, is a handsome, tile-roof, press-brick structure, and consists of two distinct portions, one containing an office and laboratories; the other comprises a large mill room, an engine room, and a boiler room.

EQUIPMENT.—The mill room is equipped with first-class machinery, of standard sizes, for crushing and concen-

tration of ores, the plant containing a Dodge Rock Breaker, Cornish Rolls, Stamp Battery with Automatic Feeder, Calumet Hydraulic Classifier, Inlet Discharge, Separator, Hartz Jig, Spitzkasten, Parsons-Rittinger Percussion Tables, Frue Vanner, Grinding and Amalgamating Pan and Settler, with Settling Boxes. In addition to these, working models of different types of concentrators have been made by students of the School of Mines and contributed to its outfit. The reduction plant consists of a Reverberatory Roasting Furnace, and 20-inch Waterjacket Cupola Furnace, with Root Blower, for lead and copper ores. There are also assay and cupellation furnaces, and before the beginning of next term it is hoped that a zinc distillation furnace will have been erected. A barrel chlorination outfit has also been added, and the Ingersoll-Sergeant Drill Co. has presented the school with one of its steam and compressed air drills, with which the classes in mining are given experience in drilling.

The Metallurgical Department is also equipped with clay testing apparatus, including the latest type of German made special fire-clay testing furnaces and accessories, and also the Keiser and Schmidt modifications of LeChatilier's thermo-electric pyrometer for the measurement of high temperature.

The power for the above plant is derived from a 50 H. P. automatic engine, taking steam from two 35 H. P. tubular boilers.

By means of this equipment students receive practical instruction in the crushing and concentration of various ores, and in the metallurgical treatment of ores of lead, zinc, copper, gold and silver.

CHEMICAL LABORATORY.

This building has lately had its floor-space increased threefold by the addition of a second story and two wings. The main building is one hundred and two feet in length by fifty-five feet in width. Each wing is about fifty-five by sixty feet and one story high.

FIRST FLOOR.

THE CHEMICAL LECTURE ROOM, occupying the entire south wing, is an exceptionally well-lighted room; a long lecture desk, with gas and water connections for lecture experiments, and a capacious glass hood and side desk fit it admirably for demonstration purposes with large classes.

At present this room is also used for general assembly meetings, and for special lectures, its seating capacity being about 500.

STOCK ROOM.—The basement under the Lecture Room is used for the storage of the large amount of apparatus, glassware and chemicals necessary to operate the department.

STORE ROOM AND DISPENSING ROOM.—These are conveniently located in the south end of the main building, and are connected with the Lecture Room and Laboratories. From them supplies are issued to the students.

FRESHMAN LABORATORIES.—These occupy the greater part of the eastern half of the first floor. The larger one is sixty by thirty feet. It contains four long desks with fifty-two sets of lockers and drawers, also a long line of hoods and a side shelf for stock reagents. The other one, thirty feet square, is equipped with tile-top desks, containing forty-eight sets of lockers and drawers.

The capacity of these two Laboratories is one hundred students, working in two sections.

QUALITATIVE ANALYSIS AND INORGANIC PREPARATIONS.—The western half of the first floor of the main building is used for qualitative analysis and for the work in inorganic preparations. Forty students, each with five or six feet of desk room, can be accommodated at one time. A long line of hoods extend along two walls. Partitioned off from this room, and leading to the south wing, there is a passage way in which drying and crystallizing closets, a large still, and the machines (centrifugals, filter presses, bag filters, etc.) for use in inorganic preparations are to be placed.

PRIVATE LABORATORIES.—There are two Instructors' Offices and Laboratories on this floor. These are small rooms,

fifteen feet square, fitted with work benches, hood, water, gas, water pressure, etc.

SECOND FLOOR.

MAIN OFFICE AND PRIVATE LABORATORY.—The Department Office and the main Private Laboratory are on this floor.

SUB-DISPENSING ROOM.—To better facilitate accurate and rapid work, the supplies for the quantitative analysis students are stored away from possible contamination, and are issued from a carefully kept stock in the south east room on the second floor.

QUANTITATIVE ANALYSIS ROOM.—A large room, occupying almost all the western half of the second floor, eighty feet long by thirty feet wide. It is fitted with eight and a half double desks, each fifteen feet long and accommodates fifty-one students at one time.

One large central trough, with fourteen taps, furnishes the necessary water supply.

Along the eastern wall there is a line of glass hoods.

SPECIAL LABORATORIES.—On the north side of the second floor are four smaller rooms for special purposes. One is used as a balance room; another as a small shop for the repair and building of instruments and appartus. The third is for electrolytic work, having all the necessary electrical connections and fittings. The largest of these rooms, ten by thirteen feet, is equipped for water analysis.

All desks and hoods on the second floor have slate tops.

FIRE ASSAY LABORATORIES.

The rooms devoted to this work are six in number, the main assay laboratory and the main locker room, a parting room, stock room, pulp balance room and fine balance room. The entire north wing of this building is devoted to this work in fire assaying.

The assaying and accessory equipment is excellent in every detail.

ROLLA BUILDING.

The fine balance room has good lighting from the north, and is made nearly as dust proof as possible. The balances are twelve in number and are of the best makes and types adjoining the fine balance room is a pulp-balance room with ten pulp balances. The last room on the north side is a well equipped stockroom.

A long locker room is situated between the main laboratory room and the balance rooms. Ample desk room is provided, the total number of lockers being seventy-seven, divided equally between the furnace room and the locker room. One end of this locker room is partitioned off into a parting room, which comprises a hood and sandbaths, a 36 burner annealer and two 8 gallon water stills.

The main furnace room has a splendid equipment, consisting of the following furnaces, eight LL, double-muffle, soft-coal, assay furnaces, 4 pot or wind furnaces for crucible work, 6 gasoline furnaces (combination muffle and crucible.) In addition to the above the Department has four double muffle furnaces similar to the ones now in use. These will be held in reserve until they are needed. The accessory apparatus consists of bins, bucking-iron and muller, hand crusher, sampler, screens, etc., etc. The furnace room has a concrete floor.

ROLLA BUILDING.

This building was originally built by the City of Rolla for a high school building, but was sold to the State, and for many years was the principal building of the School of Mines and Metallurgy. It is a brick structure, 90 by 60 feet, four stories high, including a working basement. It contains the offices and geological collections of the State Geological Survey, Recitations Rooms, Laboritories, Toilet, Shower Bath and Locker Rooms.

MECHANICAL BUILDING.

This is a new two-story brick building 150 ft. by 60 ft. specially designed for mechanical work. The second floor is used for Freshman drawing, bench work in wood and a temporary gymnasium. The first floor contains a lathe room for wood turning, a forge room, a metal working room and a stock and tool room.

Each floor is provided with a lavatory and lockers and an office for the Superintendent.

Lathe Room.—This room is 50 ft. by 30 ft. with an L 30 ft. by 16 ft and is equipped with twenty Fay and Egan 12 inch swing, college, wood lathes with iron shears. These lathes are fitted up with special fixtures and attachments, designed for this institution. The other machines are a Fay and Egan 27 inch planer; a Fay and Egan band saw with 30 inch wheels, an Oliver Universal saw table and two Oliver wood trimmers, a Sterlinger hollow chisel mortise machine; a Beach jig saw, a Brown and Sharpe grindstone; and the necessary benches, specials, tools etc., required for the best work of this character. The machinery in this room is driven by a 30 H. P. electric motor.

Forge Room.—This room is 64 ft. by 30 ft. and contains twenty four Buffalo Forge Company down draft forges and is being equipped with a power hammer, drill press, power shears, emery grinder, modern benches, small tools etc., required for the most thorough work of this character.

Metal Room.—This room is 64 ft by 30 ft, but is not yet equipped. It is expected that the necessary machinery will be installed before the beginning of the next school year.

Stock and Tool Room.—This room is 30 ft. by 24 ft. and contains the stock for use in the forge and metal rooms and also all of the special tools required in the several departments. These special tools are issued on the check system in vogue in the best manufacturing establishments.

Drawing Room.—This room is 60 ft. by 50 ft. and occupies the entire south end of the second story. It is well lighted

NORWOOD HALL.

and equipped with models, desks and lockers, and is devoted to the work in mechanical draughting and free-hand drawing.

Wood Bench Work Room.—This room is 50 ft. by 60 ft., and is equipped with benches, each fitted up with a complete set of hand tools required for this class of work, an instructors bench, a Brown and Sharpe grindstone driven by an electric motor, and the necessary trestles, clamps etc.

Temporary Gymnasium Room.—This room is 50ft. by 50 ft.

NORWOOD HALL.

This is a handsome structure, 140 ft. by 85 ft., four stories in height; built of press brick and cut stone. It is heated and ventilated by the fan system, and is equipped throughout with water, gas, electric and plumbing fixtures.

It contains adequate quarters for the Administrative Offices and the Departments of Physics, Mineralogy, and Geology and Civil Engineering.

The Physical Laboratory occupies the basement floor. In addition to the General Laboratory there is a Photometer Room, a Constant Temperature Room, a Storage Battery Room, an Electrical Testing Room, and a Laboratory for special work.

This floor also contains a Blower and Fan Room, for heating and ventilating the building; Toilet and Shower Bath Room cement laboratory; Petrographical Laboratories and Mineralogical collections.

The first floor contains the Physics Lecture Room, Physics Apparatus Room and Study; one General Lecture Room, Instrument Room for surveying instruments, the General Library, Library Reading Room, Cloak and Toilet Rooms.

The second floor contains Administration Offices, Faculty Room, Lecture Room, Geological, and Mineralogical Laboratories, Photographic Room, Private Laboratory and Toilet Rooms.

The third floor contains a Lecture Room, two Drawing Rooms, Blue Print Room, Mineralogical collections and Laboratory, Toilet and other rooms.

ADMINISTRATIVE OFFICES.—The east end of the second floor of this building is devoted to the use of the Administrative Department. There is a Director's office, reception room, stenographers' office, record room and a room reserved for the uses of visiting committees, Board of Curators, etc.

LIBRARY.—The Library contains between 5000 and 6000 carefully selected volumes. Good collections of works upon Engineering, Mathematics, Chemistry, Physics, Mining, Metallurgy, Geology and Mineralogy, afford to students in these departments an opportunity to pursue an extended course in reading in connection with their class work. The Library also contains the standard works in English and American Poetry, Fiction, Biography and History. It is well provided with encyclopaedias and works for general reference. It is open and in charge of the Librarian from 9 a. m. to 12m. and from 1 p. m. to 5 p. m. During these hours books may be taken out and the Library room used for reading and study.

A well lighted room, 39 x 45 ft. has been furnished in an attractive manner for a Reading Room. It is located on the first floor of the building, and is adjacent to the Stack Room.

The Stack Room has been recently equipped with new steel stacks, and the Library is now being catalogued according to the Dewey System. The School has, for the present Biennial Period, a special appropriation for its Library, and the number of books is rapidly increasing.

The following periodicals and newspapers for the current year are found on the reading tables:

Atlantic Monthly.
American Journal of Science.
American Mathematical Monthly.
American Geologist.
American Chemical Journal.
American Machinist.
American Blacksmith.
Annales de Chimie et de Physique.
Annals of Mathematics.
Berg und Huttenmanische Zeitung.
Cement Age.
Century.
Compressed Air.
Chemical News.
Comptes Rendus.
Cosmopolitan.
Electrical World.
Electrician (London).
Engineering News.
Engineering Magazine.
Engineering Record.
Engineering Review.
Engineering and Mining Journal.
Electro-chemical Journal.
Electric Journal.
Economic Geology.
Harper's Magazine.
Harpers Weekly.
Harvard Engineering Journal.
Journal of the Chemical and Metallurgical Society of South Africa.
Journal of the Iron and Steel Institute.
Journal of the Society of Chemical Industry.
Journal of the (English) Chemical Society.
Journal of the American Chemical Society.
Journal of the Franklin Institute.
Library Journal.
Life.
Literary Digest.
London Mining Magazine.
McClure's Magazine.
Iron and Steel Magazine.
Iron and Machinery World.
Ice and Refrigeration.
Mines and Minerals.
Mining and Scientific Press.
Mining Reporter.
Mineral Collector.
Mining Magazine.
Munsey's Magazine.
Nation.
North American Review.
Official Gazette (Washington).
Outing.
Pattern Maker.

Physical Review.
Philosophical Magazine.
Popular Science Monthly.
Power.
Revue Universelle des Mines.
Scribner's Magazine.
Stahl und Eisen.
Science.
South African Mining Journal.
Technology Quarterly.
Transactions American Society of Civil Engineers.
Transactions of the American Institute of Mining Engineers.
Transactions of the Association of Engineering Societies.
World's Work.
Zeitschrift fur Electrochemie.
Zeitschrift fur Analytische Chemie.
Zeitschrift fur Anorganische Chemie.
Zinc and Lead News.

Newspapers

Jefferson City Tribune.
Joplin Globe.
Joplin News Herald.
St. Louis Globe-Democrat.
St. Louis Republic.

Department of Mineralogy and Geology.—There are assigned to this department rooms on the second, third and basement floors of this building, as follows: A laboratory on the north side, second floor, 36 feet by 56 feet, which is fitted with hoods, tile top desks, and the necessary paraphernalia for a modern mineralogical laboratory. It will accommodate a class in blow-pipe work of from thirty-five to forty students. The northwest corner room on this floor is 28 feet by 30 feet, and is used for geological and petrographical work. The southwest corner room, 40 by 45 feet, is used by this department as a lecture room, and is equipped with a petrographical projection apparatus and stereopticon lantern. The center room on the south side is used for a Laboratory for Lithology, General and Economic Geology. There are also photographic dark rooms and ample store rooms on this floor.

The Geological and Mineralogical equipment includes a representative collection of minerals, rocks and fossils for class use; a large collection of cabinet specimens of minerals and ores, and of materials illustrating metallurgical processes.

There is also a collection of 3500 specimens, representing the mineral wealth of Missouri, consisting of ores of lead,

VIEW IN FORGE ROOM.

zinc, iron and copper, coal, clays of many sorts, and building stones. Many of the specimens are of extraordinary size and rare beauty. The minerals occurring as gangue with the metalliferous deposits of the State are also well represented. Altogether it is an unusually valuable assemblage of geological products of economic importance.

This collection was a part of the Missouri Mineral Exhibit displayed at the World's Fair at Chicago. It was presented to the School of Mines and Metallurgy by the General Assembly in 1895.

In addition to the above mentioned materials, the State Board of Equalization has recently assigned to the school the specimens, models, maps and machinery which constituted the Missouri Mining Exhibit at the St. Louis Exposition, thus bringing to the school a large amount of valuable equipment.

This department has also a very fine equipment for the study of Crystallography, consisting of a large collection of wood and glass models, microscopes, rock and mineral slides, and the complete Fuess projection apparatus for illustration of the optical properties of crystals.

A rock section machine and instruments for geological surveys are included in the equipment of this department.

Department of Physics.—The lecture room, the apparatus cabinet room, the department library and study, is on the first floor. The lecture room is a large well lighted room capable of seating one hundred students. The lecture table is provided with water, gas, and electric connections for convenience in lecture demonstrations and experiments.

The Physical Laboratory is on the ground or basement floor. There are two large laboratories, one equipped for general physical measurements in mechanics, sound, heat, etc., and one equipped for electrical measurements. There is a battery room equipped with both primary and secondary batteries connected by wires with the various laboratories and lecture room; a constant temperature room with double walls and air space insulation; a commodious dark room with blackened walls for spectrometric and photometric measurements, and a special laboratory for research work.

The equipment includes a Rowland electrodynamometer with shunts and resistances; a Leeds and Northrup Decade Wheatstone bridge; a Queen & Co., P. O. pattern, Wheatstone bridge; two portable testing sets; various Wheatstone bridges and resistance boxes; standards of resistance inductance and capacity; a Lummer-Brodhun Photometer; a Gaertner dividing engine, with linear and circular attachments; a Threlfall micromanometer; a Duddell thermo galvonometer; various tangent mirror and D'Arsonval galvanometers; a Parr coal colorimeter; a wireless telegraph demonstration set; a ten-inch induction coil; Crooke's tubes; X-Ray tubes; Toepler Holtz machine; a Schmidt and Haensch spectrometer; a Rowland diffraction grating; photographs of Rowland's normal solar spectrum; two steam indicators; tachometers and speed counters; various balances, micrometers, calipers; together with apparatus for illustrating the principles of physics.

The Dynamo Laboratory contains an assortment of direct current generators and motors, a single and a three phase generator, an induction motor, a rotary transformer, stationary transformers, three phase to two phase transformers and a Cooper Hewitt mercury vapor converter with testing instruments, which include a Weston laboratory standard voltmeter, with multipliers; a Weston laboratory standard millivoltmeter, with shunts; a Kelvin electrostatic voltmeter; Weston portable D. C. ammeters; Weston portable D. C. and A. C. voltmeters; Weston and Thomson portable wattmeters; Thomson A. C. voltmeters; electrodynamometers; a Grassot fluxmeter; inductance coils, condensers, etc.

Department of Civil Engineering.—This department occupies the greater portion of the third floor, and embraces two large draughting rooms amply lighted and equipped for the work above the Freshman year; a blue-print room, conveniently arranged for taking prints; two large lecture rooms, a department library and study. There is an instrument room on the first floor for storing the instruments in daily use.

The equipment for field practice includes two Gurley Y levels, two Keuffel & Esser Y levels, one Buff & Buff Y level, one Buff & Berger Y level, one Brandis Y level, and one C. L. Berger & Sons Dumpy level; one Gurley transit, one Young

VIEW ON CAMPUS.

transit, one Heller & Brightly transit with solar attachment, one Saegmuller transit with solar attachment, two Keuffel & Esser transits, one Buff and Buff transit, and one C. L. Berger & Sons transit; one Gurley solar compass; one plane table with stadia attachments; two sextants; one Gurley current meter; one aneroid barometer; six stadia slide-rules; with necessary chains, tapes, level-rods, poles, hatchets, etc.

A cement testing laboratory in the basement is equipped with the necessary apparatus.

ADMISSION.

Under the statutes persons of either sex, sixteen years of age or over, whether residents of Missouri or not, are admisible upon evidence of sufficient preparation. Students should acquire a good liberal education, its elements at least, before beginning technical study. The average age of members of the present Freshman Class at entrance was about 18. Specific requirements have been fixed by considerations of the express design of the school—"to promote the education of the industrial classes" in certain branches of engineering—and of the educational opportunities of its intended beneficiaries. The requirements for admission to the Freshman Class as follows:

The applicant must file with the Director a satisfactory certificate of good moral standing.

Admission by Examination.—Applicants for admission, not having diplomas from approved schools, are required to pass, without conditions, examinations in fourteen units, a unit being equivalent of a year's work in one subject, as given in an approved High School.

Of these fourteen units the following are required:

English,	3
Algebra,	2
Plane Geometry,	1

The remaining eight units may be selected from the following list:

Subject.	Maximum.	Minimum.
English,	4	3
Algebra,	2	2
Plane Geometry,	1	1
Solid Geometry,	½	½
Plane Trigonometry,	½	½
History,	4	1
Latin,	4	1
Greek,	3	1
German,	3	1
French,	3	1
Spanish,	3	1
Physics,	2	1
Chemistry,	2	1
General Biology	2	1
Zoology,	2	1
Botany,	2	1
Drawing,	1	1
Shopwork,	1	1

ADMISSION ON DIPLOMA.—Applicants may be admitted upon cerificate from a college or a preparatory school, when the faculty is satisfied that the work certified to covers the requirements of the School of Mines and Metallurgy.

Each applicant must file with his diploma a statement, on a School of Mines and Metallurgy blank, from his superintendent or principal, showing that the applicant has to his credit fourteen units.

Following is a list of schools whose courses have been approved by the University, and whose diplomas will admit to the Freshman Class without examination:

ACCREDITED SCHOOLS.

Albany High School.
Alton (Ill.) High School.
Aurora High School.
Bethany High School.
Blees Military Academy, Macon.
Bloomfield High School.
Bonne Terre High School.
Boonville High School.
Brookfield High School.
Buchanan College, Troy.
Butler High School.
Cairo (Ill.) High School.
California High School.
Cameron High School.
Carrollton High School.
Carthage High School.
Caruthersville High School.
Chillicothe High School.
Christian College, Columbia.
Clinton High School.
Columbia High School.
Columbia Normal Academy.

Covington (Ind.) High School.
Culver (Ind.) Military Academy.
Davenport (Ia.) High School.
DeSoto High School.
Doniphan High School.
East St. Louis (Ill.) High School.
Everton High School.
Excelsior Springs High School.
Fort Scott (Kan.) High School.
Fort Smith (Ark.) High School.
Gallatin High School.
Greenfield High School.
Greenville (Miss.) High School.
Hamilton High School.
Hannibal High School.
Hardin College, Mexico.
Harrisonville High School.
Holden High School.
Hosmer Hall, St. Louis.
Hot Springs (Ark.) High School.
Iberia Academy.
Independence High School.
Jefferson City High School.
Joplin High School.
Kahoka High School.
Kansas City Central High School.
Kansas City Manual Training School.
Kansas City (Kan.) High School.
Kemper Military School, Boonville.
Keokuk (Iowa) High School.
Kewanee (Ill.) High School.
Kidder Institute, Kidder.
King City High School.
Kirksville High School.
Kirkwood High School.
Lamar High School.
Lancaster High School.
Leavenworth (Kan.) High School.
Lexington High School.
Louisiana High School.
Macon High School.
Marionville Collegiate Institute.
Marshall High School.
Mary Institute, St. Louis.
Maryville High School.
Memphis High School.
Mexico High School.
Miami High School.
Michigan Military Academy, Orchard Lake, Mich.
Milan High School.
Missouri Military Academy, Mexico.
Moberly High School.
Monroe City High School.
Montgomery City High School.
Mound City High School.
Mt. Vernon High School.
Neosho High School.
Nevada High School.
New London High School.
Norborne High School.
Odessa High School.
Oklahoma City (Okla. High School.)
Oregon High School.
Palmyra High School.
Paola (Kan.) High School.
Paris High School.
Pierce City High School.
Pine Bluff (Ark.) High School.
Pleasant Hill High School.
Poplar Bluff High School.
Princeton High School.
Quincy (Ill.) High School.
Rich Hill High School.
Richmond High School.
Ridgeway High School.
Rogers Academy, Rogers, Ark.
Rolla High School.
St. Joseph High School.
St. Louis Central High School.
St. Louis McKinley High School.
St. Louis Manual Training School
Sedalia High School.
Shelbina High School.
Shelbyville High School.
Slater High School.
Smith Academy, St. Louis.
Springfield High School.
Sweet Springs High School.
Tipton High School.
Trenton High School.
Unionville High School.
University Academy, Columbia.
University Military School, Mobile, Ala.
Vandalia High School.
Walther College, St. Louis.
Warrensburg High School.
Washington High School.
Webb City High School.
Webster Groves High School.
Wentworth Military Academy, Lexington.
Westport High School.
Windsor High School.
Yeatman High School, St. Louis.

ADVANCED STANDING.—Candidates may be admitted to "advanced standing" (that is to enter the Sophomore or the Junior class) either upon examination in the subjects of the previous year or years, or upon certificate from another institution, of work accomplished, which is, in the estimation of the Faculty, equivalent to that completed here by the class into which entrance is sought. Applicants for advanced standing should communicate with the Director as early as possible.

SPECIAL STUDENTS.*—Special Students will be admitted without passing the regular examinations required for entrance, under the following conditions: 1. They must be at least twenty-one years of age. 2. They must show good reasons for not taking a regular course. 3. They must pass such examinations or other tests as shall demonstrate fitness to pursue profitably all the subjects selected by them. 4. They shall not be candidates for a degree. 5. Special students are expected to do specially good work in the subjects which they choose. If, at any period of the session, their work becomes unsatisfactory, their connection with the school will be severed.

When the work is chiefly of a laboratory nature they will be required to take at the same time as much class-room work as the Faculty may designate for each particular case.

Since there are many persons who would profit by the opportunities for education offered at the school, but who are unable, through lack of time or preliminary training, to undertake the work of the regular course, the Faculty has made the above provision. In this way it hopes to broaden the usefulness of the school, and to enable it to fulfill its purpose in as liberal a manner as possible.

DEGREES.

1. The degree of Bachelor of Science in Mining Engineering, Bachelor of Science in Chemistry and Metallurgy, or Bachelor of Science in Civil Engineering, will be conferred on students who have attained the required standard in all the subjects of instruction in Courses I, II or III.

VIEW IN FORGE ROOM.

2. The degree of Bachelor of Science will also be conferred on students who have satisfactorily completed Course IV in General Science.

The degree of Master of Science will be given to students who have completed satisfactorily a year's post graduate work in residence at the school.

3. The further degree of Engineer of Mines, Civil Engineer or Metallurgical Engineer, will be conferred on one who, having previously been graduated in I, II or III, has completed satisfactorily a year's post-graduate work in residence here, or who has had professional experience in a responsible position for not less than three years.

Each applicant for a degree above the Bachelor of Science degree is required to present to the Faculty a satisfactory thesis, recording the result of some original investigation or independent research in a subject connected with his course. It must be accompanied by such drawings as may be necessary to illustrate it, and a copy of it must be deposited with the Librarian for preservation.

COURSES OF STUDY.

It is the object of the instruction at this institution, first, to lay a broad and solid foundation in the way of acquaintance with principles and theory, and to supplement this, wherever possible, by the discipline of practical application in the laboratory and field. Lectures and recitations are arranged to come in the morning hours, leaving the afternoon for laboratory and field work. The practical work is designed to illustrate and impress principles, to familiarize the student with the use of instruments with which he is to be concerned in the work of his profession, and to afford an opportunity for original investigation. "Head-work" and "hand-work" go together. What is taught orally in the lecture room is applied and illustrated in the laboratory.

The School of Mines offers four regular courses leading to degrees, and several special courses, the former extend through four years, and are:

I. Mining Engineering.
II. Metallurgy and Chemistry.
III. Civil Engineering.
IV. General Science.

The first is a general course in Mining Engineering, having in view all the operations in connection with mining, from the prospecting for the mine to the delivery of the finished product on the market.

The second contemplates especially processes in Mining and Metallurgy subsequent to the delivery of the ore above ground. It fits a man for positions in connection with concentrating plants and smelters and various branches of industrial chemistry.

The third is a course in Engineering as applied especially to Railways, Highways and Municipal Works.

The fourth is largely elective and provides for a liberal education in General Science.

The engineering courses are practically the same in the Freshman year, and differ but slightly in the Sophomore. The student has thus an opportunity to defer his choice of a specialty until he has spent some time in technical study, and can better estimate his inclinations and capacities.

To each lecture or recitation one hour is devoted. The afternoon periods, given to Laboratory, Drawing and Field Work, are of three hours duration.

SPECIAL COURSES.

In addition to the four regular courses leading to degrees, mentioned above, a number of shorter courses are also offered. They are: *Chemistry and Assaying*, *Mining*,

Surveying and Electricity. They have been planned for the benefit of those who, for various legitimate reasons, are unable to take the regular four year courses.

The course in *Assaying and Technical Analysis* will require two years' work, although mature students, who have already some knowledge of Chemistry, may complete it in one year. For description see page 42.

The purpose of the course in *Surveying* is to turn out competent land and mining surveyors and fair draughtsmen. The essentials of it are a thorough knowledge of Algebra, Geometry, Trigonometry and Surveying, Field Practice and Drawing. One school year and the first term of a second, will be required for the completion of this course.

A two years' course in *Mining* is offered to students, especially such as have had some practical experience, who may wish to fit themselves for holding important positions about mines or in ore-dressing plants, but who are unable, on acount of the lack of preparation or of time, to take the full course in Mining Engineering. Besides Mathematics this course embraces General Chemistry, Assaying, Mineralogy, Geology, Mining, Surveying, English, etc.

A course in *Electricity* is offered to furnish the student with the theory of Electricity, and acquaint him with its application in the arts. This subject is of prime importance to every engineer, especially to the Mining Engineer, since electricity has become such an important factor in mining operations.

See remarks on special students, page 28, and outline of special courses, page 42, et seq.

EXCURSIONS.

VOLUNTARY.

A summer excursion for students who have passed their junior work, to the deep mining district of the Rocky Moun-

tains or Lake Superior. Geological phenomena, mines and ore dressing and metallurgical plants will be the subjects of study.

REQUIRED.

A.—At the close of the sophomore year, three weeks of summer field work for practice in topography, lines of communication, etc., will be required of students in Civil Engineering. This work will be carried on in the vicinity of Rolla.

B.—At the close of the junior year, students in Mining and Metallurgical Engineering will make a four weeks' excursion to Southeast and Southwest Missouri, for the purpose of practice in mine surveying and of studying Field and Economic Geology, Mining and Ore Dressing.

C.—An excursion by the senior class to Steelville, Sligo and Palmer, for the purpose of studying iron and lead deposits and methods of reduction. This excursion will take place during the latter part of the senior year.

D.—An excursion by the senior class to Herculaneum, St. Louis, Granite City, and the coal fields of Illinois. This excursion will take place in the latter part of the senior year.

E.—At the close of the school year, in June, one week's field work in Topography by all sophomores not taking A.

APPROACH TO MINING BUILDING.

COURSE I.—MINING ENGINEERING.

FRESHMAN YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
Higher Algebra	5	.....	.....
Solid Geometry	3	.....	.....
Descriptive Geometry	.....	1	1
Trigonometry	.....	5	.....
Analytic Geometry	.....	.....	5
General Chemistry	5	5	5
English	5	5	5
LABORATORY WORK:			
General Chemistry	3	3	3
Drawing, Mechanical	6	6	6
Shop Practice	6	6	3
Themes	1	1	1
Descriptive Geometry Drawing	.....	5	5

SOPHOMORE YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
Calculus	5	5	5
German, French or Spanish	5	5	5
Surveying	5	.....	.....
Lines of Communication	.....	.....	3
Elementary Mechanics	.....	2	.....
General Physics	.....	.....	5
Crystallography	.....	3	.....
Qualitative Analysis	1	1	.....
LABORATORY WORK:			
Qualitative Analysis	6	6	.....
Mineralogy	.....	6	6
Physics	.....	.....	6
Surveying	6	.....	3
Topography one week	.....	.....	48
Themes	1	1	1
Forge Work	6	6	.....
Shop Work	.....	3	.....

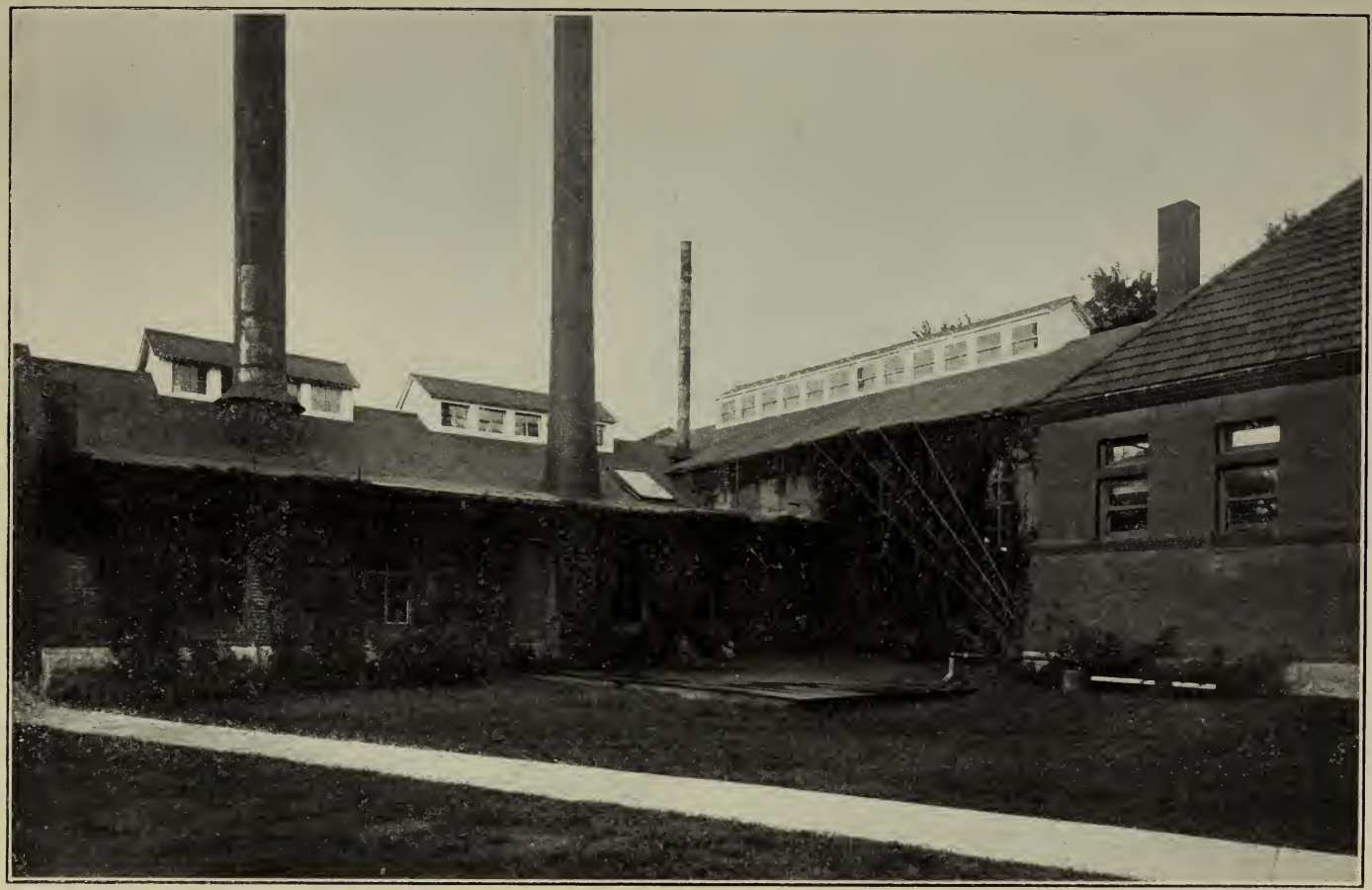
JUNIOR YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
General Physics	5	.....	.....
Mechanics	5	.....	.....
Mechanics of Materials	.....	5	.....
Hydraulics	.....	.....	5
General Geology	3	3	3
Thermodynamics	.....	5	.....
Ore Dressing	3	3	.....
Metallurgy (M-2)	.....	.....	5
Masonry	2	.....	.....
Dynamo Machinery	.....	.....	3
Assaying (M-1)	.....	2	.....
LABORATORY WORK:			
Quantitative Analysis	7½	4½	6
Physics	6	.....	.....
Steam	.....	3	.....
Geology	1½	1½	3
Ore Dressing	4	.....	.....
Drawing and Graphics	.....	3	3
Dynamo	.....	.....	6
Assaying (M-1)	.....	9	.....

Summer Excursion—4 weeks.

SENIOR YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
Frame Structures	5	.....	.....
Alternating Currents	5	.....	.....
Electrical Transmission	.....	3	.....
Metallurgy (M-3-4-5)	5	4	4
Economic Geology	2	2	5
Mining	.....	3	3
Compressed Air	.....	2	.....
Contracts and Specifications	.....	.....	2
Metallurgy Conference (M-12)	2	1	1
LABORATORY WORK:			
Metallurgy (M-14)	4	7	.....
Alternating Currents	6	.....	.....
Mill Design	6	.....	.....
Mining Problems	.....	3	3
Metallography (M-15)	.....	6	.....
Electrical Problems	.....	3	.....
Graphics	3	.....	.....
Special Investigation	.....	.....	9



POWER HOUSE.

COURSE II.—METALLURGY AND CHEMISTRY.

FRESHMAN YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
Higher Algebra	5	.....	.....
Solid Geometry	3	.....	.....
Descriptive Geometry	.....	1	1
Trigonometry	.....	5	.....
Analytic Geometry	.....	.....	5
General Chemistry	5	5	5
English	5	5	3
German (Elementary)	.....	4	4
Qualitative Analysis	.....	1	1
LABORATORY WORK:			
General Chemistry	9	.....	.....
Qualitative Analysis	.....	9	9
Drawing (Mechanical)	6	6	6
Descriptive Geometry Drawing	.....	5	5
Themes	.....	.....	.....

SOPHOMORE YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
Calculus	5	5	5
German (Scientific)	5	5	4
Surveying	5	.....	.....
Elementary Mechanics	.....	2	.....
General Physics	.....	.....	5
Crystallography	.....	3	.....
Quantitative Analysis	2	2	2
English	1	1	1
Physical Chemistry	.....	.....	2
LABORATORY WORK:			
Quantitative Analysis	9	12	6
Surveying	6	.....	.....
Mineralogy	.....	6	6
Physics	.....	.....	6

JUNIOR YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
General Physics	5	.....	.....
Analytic Mechanics	5	.....	.....
Hydraulics	.....	.....	5
General Geology	3	3	3
Ore Dressing	3	3	.....
Quantitative Analysis	2	3	.....
Assaying (M-1)	.....	2	.....
Electrochemistry	.....	3	2
Metallurgy (M-2)	.....	.....	5
Dynamo Machinery	.....	.....	3
Constitution of Alloys (M-6)	.....	2	.....
Memoirs (Chemical)	.....	1	.....
LABORATORY WORK:			
Quantitative Analysis	7½	6	.....
General Geology	1½	1½	3
Electrochemistry	.....	3	6
Metallurgy (Special M-13)	.....	.....	3
Physics	6	.....	.....
Assaying (M-1)	.....	9	.....
Dynamo	.....	.....	6
Ore Dressing	4	.....	.....

SENIOR YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
Alternating Currents	5	.....	.....
Electrical Transmission	.....	3	.....
Economic Geology	2	2	5
Metallurgy (M-3, M-4, M-5)	5	4	4
Metallurgy Conference (M-12)	1	1	1
Metallurgy Organization (M-8)	.....	4	.....
Metallurgy Problems (M-10)	.....	.....	4
Metallurgy Accounting (M-9)	.....	3	.....
Electrochemical Analysis	.....	1	.....
Electrometallurgy (M-7)	2	.....	.....
Quantitative Analysis	2	.....	.....
Memoirs (M-11)	1	.....	1
Contracts	.....	.....	2
LABORATORY WORK:			
Mill Design	6	.....	.....
Quantitative Analysis	6	.....	.....
Alternating Currents	6	.....	.....
Metallurgy (M-14)	4	7	.....
Electrochemistry Analysis	.....	3	.....
Electrometallurgy (M-7)	.....	.....	3
Metallurgy Accounting (M-9)	.....	3	.....
Metallography (M-16)	.....	6	.....
Electrical Problems	.....	3	.....
Advanced Chemical Analysis or Metallurgy	.....	.....	6
Metallurgy or Electrometallurgy Designing (M-17)	.....	.....	6

COURSE III.—CIVIL ENGINEERING.

FRESHMAN YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
Higher Algebra	5	.....	.....
Solid Geometry	3	.....	.....
Descriptive Geometry	.....	1	1
Trigonometry	.....	5	.....
Analytic Geometry	.....	.....	5
General Chemistry	5	5	5
English	5	5	5
LABORATORY WORK:			
General Chemistry	3	3	3
Drawing, Mechanical	6	6	6
Descriptive Geometry Drawing	.....	5	5
Shop Practice	6	6	3
Themes	1	1	1

SOPHOMORE YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
Calculus	5	5	5
German, French or Spanish	5	5	5
Surveying	5	.....	.....
Lines of Communication	.....	.....	3
English Literature	1	1	.....
Elementary Mechanics	.....	2	.....
General Physics	.....	.....	5
Geodesy	.....	3	.....
LABORATORY WORK:			
Surveying, Field Practice	9	.....	9
Geodesy, Computations and Drawing	.....	9	.....
Physics	.....	.....	6
Topography, one week	.....	48	.....
Themes	1	1	1
Forge Work	6	6	.....

Summer Excursion—3 weeks.

VIEW ON CAMPUS.

JUNIOR YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
General Physics	5	.....	.....
Mechanics	5	.....	.....
Mechanics of Material	.....	5	.....
Hydraulics	.....	.....	5
General Geology	3	3	3
Thermo Dynamics	.....	5	.....
Masonry Construction	2	.....	.....
Dynamo Machinery	.....	.....	3
Roads and Pavements	.....	.....	3
Railroad Economics	.....	.....	2
Astronomy	.....	2	.....
LABORATORY WORK:			
Physics	6	.....	.....
Steam	.....	3	.....
Geology	1½	1½	3
Drawing and Graphics	6	6	6
Dynamo	.....	6	6
Cement and Concrete	3	.....	.....

SENIOR YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
Frame Structures	5	.....	.....
Alternating Currents	5	.....	.....
Electric Transmission	.....	3	.....
Compressed Air	.....	2	.....
Contracts and Specifications	.....	.....	2
Water Supply	5	.....	.....
Sanitary Engineering	.....	5	.....
River and Harbor Improvement and Irrigation	.....	.....	5
Masonry Designs and Concrete Steel	.....	.....	2
Bridges (Higher Structures)	.....	5	.....
Metallurgy of Steel	.....	.....	5
LABORATORY WORK:			
Alternating Currents	6	.....	.....
Electrical Problems	.....	3	.....
Engineering Designs	9	2	.....
Special Investigation	.....	.....	15

COURSE IV.—GENERAL SCIENCE.

FRESHMAN YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
Higher Algebra	5	.....	.....
Solid Geometry	3	.....	.....
Trigonometry	.....	5	.....
General Chemistry	5	5	5
English	5	5	5
German	.....	4	4
LABORATORY WORK:			
General Chemistry	3	3	3
Drawing	6	6	6
Themes	1	1	1
Elective	6	6	6

SOPHOMORE YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
German	5	5	5
English	5	5	5
General Physics	.....	.....	5
Qualitative Analysis	1	1	.....
Elementary Mechanics	.....	2	.....
LABORATORY WORK:			
Qualitative Analysis	6	6	.....
Physics	.....	.....	6
Elective	9	9	9
Themes	.....	.....	.....

FRESHMAN DRAWING ROOM.

JUNIOR YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
French or Spanish	5	5	5
General Physics	5	.....	.....
General Geology	3	3	3
Crystallography	.....	3	.....
Elective	2	5	8
LABORATORY WORK:			
Physics	6	.....	.....
Geology	1½	1½	3
Mineralogy	.....	6	6
Elective	6	6	6

SENIOR YEAR.

All elective.

Selection of studies subject to approval of Faculty.

Electives after Sophomore year along one of the two lines. Physics and Mathematics, or Chemistry and Geology. Twenty hours recitation or fifteen hours recitation and five afternoons laboratory work constitute a course.

SPECIAL COURSE IN MINING, CHEMISTRY AND ASSAYING.

FIRST YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
Higher Algebra	5	.....	.....
Solid Geometry	3	.....	.....
Trigonometry	.....	5	.....
English	5	5	5
General Chemistry	5	5	5
Elective	.....	.....	6
Qualitative Analysis	.....	1	1
LABORATORY WORK:			
General Chemistry	9	.....	.....
Qualitative Analysis	.....	9	9
Drawing, Mechanical	6	6	6

SECOND YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
Surveying	3	.....	.....
Lines of Communication	.....	.....	3
Ore Dressing	3	3	.....
General Geology	3	3	3
Mining	.....	3	3
Assaying	.....	2	.....
LABORATORY WORK:			
Surveying, Field Practice	6	.....	3
Ore Dressing	4	.....	.....
Mineralogy	.....	6	6
General Geology	$1\frac{1}{2}$	$1\frac{1}{2}$	3
Quantitative Analysis	$7\frac{1}{2}$	$4\frac{1}{2}$	6
Assaying	.....	9	.....

SPECIAL COURSE IN ELECTRICITY.

FIRST YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
Higher Algebra	5	.....	.....
Solid Geometry	3	.....	.....
Trigonometry	.....	5	.....
Analytic Geometry	.....	.....	5
General Chemistry	5	5	5
English	5	5	4
Electricity and Magnetism	.....	3	.....
LABORATORY WORK:			
General Chemistry	3	3	3
Drawing, Mechanical	6	6	6
Shop Practice	6	6	6
Physics	.....	3	.....

SECOND YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
Elementary Mechanics	.....	2	.....
General Physics	5	.....	5
Calculus	5	5	5
Dynamo Machinery	.....	.....	3
Thermodynamics	.....	5	.....
Elective	6	8	3
LABORATORY WORK:			
Physics	9	9	9
Elective	6	3	6
Steam	.....	3	.....

SPECIAL COURSE IN SURVEYING.

FIRST YEAR.

	TIME IN HOURS PER WEEK.		
	FIRST TERM.	SECOND TERM.	THIRD TERM.
LECTURES AND RECITATIONS:			
Higher Algebra	5	.....	.....
Solid Geomerty	3	.....	.....
Trigonometry	.....	5	.....
English	5	5	5
Elective	2	5	10
LABORATORY WORK:			
Drawing	6	6	6
Field Practice	.....	.....	6
Elective	9	9	3

SECOND YEAR.

LECTURES AND RECITATIONS:

Surveying	5	hours	per week
Elective	10	"	"
Field Practice	9	"	"
Drawing	6	"	"

VIEW ON CAMPUS.

DEPARTMENT OF MATHEMATICS.

PROFESSORS DEAN AND GARRETT.

The study of mathematics, as pursued at this school, is chiefly for the purpose of acquiring a working knowledge of its use in the subsequent studies of engineering, physics and chemistry, and not merely as a component part of a general education. Great care is accordingly exercised to insure the attainment of skill in practical applications requiring analytical powers as well as mere computation. Frequent written reviews test the proficiency of the student.

Advanced standing is given only when equivalent work has been done in a school of engineering.

PRESCRIBED WORK.

1. *Solid and Spherical Geometry.*—The usual college course supplemented by lectures and problems of special interest to engineers, such as projections, prismoidal formulae and their application in calculation of earth work, masonry, capacity of tanks and reservoirs.

Freshmen, first term, three hours per week.

2. *Graphic Algebra, Curve Tracing and Algebraic Analysis.*—This course is designed to fit students for the study of analytic geometry and calculus. It embraces the following topics: Solution of quadratic equations; theory of quadratic expressions; solution of higher numerical equations, graphically and arithmetically; theory of integral algebraic functions; tracing of curves having simple numerical equations; graphical and arithmetical calculation of coefficients of empirical formulae; convergency of infinite series; use of infinite series in approximate calculations; practical applications of the binomial theorem; errors of observation; method of least squares.

Freshmen, first term, five hours per week.

3. *Trigonometry, Plane and Spherical.*—This subject, the most important in the mathematical equipment of the engineer, is given due prominence. The student is drilled, not only in the solution of triangles and other geometrical prob-

lems, but in the applications of the trigonometric functions in analysis and in shortening computations.

Freshmen, second term, five hours per week.

4. *Analytic Geometry.*—Equations of straight lines under given conditions; the straight line as locus; relations of two or more straight lines; equations of circles under given conditions; the circle as locus; intersections of curves and straight lines; equation of tangent to any curve; asymptotes; classification of curves of second degree; plotting curves of second degree from numerical equations; center of conic section; diameters; relation of diameters and tangents; determination of foci, eccentricity and directrices of conic section; study of special forms of equation of second degree; reduction of general equation to simplest form.

The work in solid analytic geometry is given in connection with the differential and integral calculus.

Freshman, third term, five hours per week.

5. *Differential Calculus.*—Graphic representation of functions; algebraic and geometrical limits; derivatives of algebraic functions; geometrical problems in maxima and minima involving algebraic functions; tangents, normals and asymptotes; tracing curves having singular points; derivatives of trigonometric functions; problems in maxima and minima; kinematical problems; derivatives of inverse trigonometric functions; derivatives of complex functions; Maclaurin's Theorem and applications; Taylor's Theorem and applications; functions of two variables; tangent planes and normals.

Sophomore, first term, five hours per week.

6. *Integral Calculus.*—An attempt is made to ground the student so thoroughly in the integration of the functions most commonly occurring in mechanics and physics that he may be independent of tables of integrals. Considerable use is made of integration in series and of integration in the development of functions in series. Particular attention is given to integration as a summation.

Sophomore, second term, five hours per week.

7. *Applications of Integral Calculus.*—Areas of plane curves; lengths of curves; flow of liquids through orifices and channels; centroid of plane areas; moment of inertia of plane lamina; volumes of solids of revolution; moment of inertia of solids of revolution; centre of gravity of solids of revolution; theory of attraction and potential; differential equations of the first and second orders; partial differential equations of the first order; differential equations of mechanics and thermodynamics.

Sophomore, third term, five hours per week.

8. *Mechanics of Engineering.*—It is the aim in this course to develop the essential principles of mechanics and to render the student proficient in applying them to practical, rather than theoretical, problems. To this end, a large number of problems are solved, which, so far as possible, are selected from machines or structures with which the student is already familiar, or the study of which he is subsequently to take up. Juniors, first term, five hours per week.

Maurer's Technical Mechanics forms the basis of this course.

9. *Mechanics of Materials.*—Theory of stress, strain and elasticity and its application to the design of members of machines and structures; a discussion of the properties of the materials of engineering construction. Some of the topics which, for lack of time, cannot be adequately treated in the first term are disposed of here. Juniors, second term, five times per week.

Merriman's Mechanics of Materials, lectures and blackboard notes.

DEPARTMENT OF CHEMISTRY.

PROFS. GOTTSCHALK AND THOMPSON, MR. MOORE, MR. MANN, MR. BARRETT, MR. COOKE, MR. LANE.

1. *General Chemistry.*—A comprehensive study of the general principles of Chemistry and of the more important elements. Special attention is given to the Chemistry of the Metals. The Periodic law is followed throughout. The lectures are fully illustrated; the class is divided into several smaller sections for recitations. Freshman class, five times a week throughout the year.

2. *General Chemical Laboratory.*—The laboratory work accompanying General Chemistry, consists of experiments which are largely quantitative, and which are intended to teach stoichiometrical relations from the first. Freshman class, one afternoon per week throughout the year for E. M. and C. E.; three afternoons per week for one term in C. & M. course.

3. *Qualitative Analysis.*—For students of the course in Mine Engineering: sophomore year, first and second terms, two afternoons and one hour lecture per week.

Tests and separation of the more common metallic elements and some of the acidic elements; analysis of solutions containing phosphates; alkaline solutions; insoluble substances; alloys; natural products, slags, etc.

4. *Quantitative Analysis.*—For students of the course in Mine Engineering: juniors throughout the year, two and a half, one and a half, and two afternoons per week in the respective terms.

The work begins with a study of the balance. This is followed, for a half of the time, by accurate gravimetric analysis, first on pure soluble salts, then on natural products (dolomite, clay,) then by accurate volumetric analysis (acidimtery, alkalimetry, iron by the permanganate method.)

As samples of technical work, the wet assays as practiced in the west, are studied during the latter half of the course.

5. *Quantitative Analysis.*—For students of Metallurgy, sophomore year, the equivalent of three afternoons and two lectures weekly, throughout the year; two terms junior and one term senior.

An extended study of the balance, methods of weighing, and calibration of instruments serve as introduction to the work. Pure salts are then carefully analysed, gravimetrically and volumetrically. The third term, sophomore year, is devoted to the study of certain technical methods in vogue in the west.

CHEMICAL LABORATORY.

The student is required to analyze several igneous rocks, studying in detail the methods outlined by Hillebrand in Bulletin No. 176, of the United States Geological Survey, and by Washington in "Rock Analysis."

One term is devoted to iron and steel analysis, using Blair as a guide.

Copper, Lead and Silver bullion, slags and mattes are substances for analysis required in this course.

A short course in technical gas analysis and analysis of water for boiler use is included.

The lecture work through the three years, is devoted to an exposition of details of manipulation, general methods of analysis, theory of instruments used, general chemical theory not given in freshman chemistry, and discussion of sources of error, including testing, purification, and preparation of reagents.

Collateral reading, especially in German Scientific Journals, is one of the main features of the work.

6. *Physical Chemistry.*—A short course designed mainly as an introduction to the various kinds of chemical equilibria met by the metallurgist. Two lectures a week, third term, sophomore year, Metallurgy course.

7. *Electrochemistry.*—A theoretical introduction, followed by applications. Junior year, Metallurgy course, three lectures and one afternoon per week; third term, two lectures and two afternoons per week.

8. *Chemical Memoirs.*—Carefully prepared abstracts of current articles or of special subjects, prepared by the student. One hour a week in the second term, junior year, Metallurgy course, is taken for the discussion of these abstracts.

9. *Electrochemical Analysis.*—In the senior year, Metallurgy course, a short course in the theory and practice of electrochemistry applied to analytical work, is given for students who have had all the previous work.

DEPARTMENT OF PHYSICS.

PROF. MCRAE, MR. COOK.

1. *Elementary Mechanics.*—This subject includes the study of the simple machines and the fundamental principles of mechanics and hydrostatics. Lectures illustrated by experiments and recitations. Sophomore, second term, two times a week.

Text-Book.—Loney's Mechanics and Hydrostatics.

2. *Electricity and Magnetism.*—Lectures and recitations three hours a week during the second term. This course is designed as an introduction to the study of electricty and magnetism.

Text-Book.—Lessons in Electricity and Magnetism, by S. P. Thompson.

3. *Laboratory Work in Electricity and Magnetism.*—Three afternoons a week throughout the year.

4. *General Physics.*—The study of advanced physics is taken up during the third term of the Sophomore year, and continued during the first term of the Junior. The Sophomores study kinematics, statics, kinetics, and the mechanics of fluids during the first part of the term, and conclude with the subject of heat toward the last of the term. The study of heat includes an introduction of thermodynamics. Particular attention is paid to harmonic motion as the basis for the study of the subjects of sound, light and alternating currents of electricity.

During the first term of the Junior year the study of electricity and magnetism is taken up. Such subjects as static electrification, potential, quantity, capacity, resistance, induction, impedance, inductive capacity, electric waves, etc., are studied. During the latter part of the term the reflection, refraction, diffraction and interference of sound and light are studied. The entire course is illustrated by lecture experiments and supplemented by work in the laboratory. Five times a week.

Text-Book.—General Physics, by Watson.

5. *Laboratory Work in Mechanics, Sound, Light, Heat, Electricity and Magnetism.*—In the laboratory, the work is quantitative and aims as far as possible, to instruct the student in the methods of physical measurement and the derivation of relations between the quantities measured. Emphasis is laid upon the derivation of physical laws rather than the verification of them. Required of Sophomores two afternoons a week during the third term, and of Juniors two afternoons a week during the first term.

6. *Thermodynamics.* — A short course in theoretical thermodynamics is followed by a study of boilers, furnaces and heat engines, standard types of safety and tubular boilers, chimney and mechanical draft, pumps, heaters, etc.; steam, gas and gasoline engines are studied. Recitations and lectures are supplemented by the equivalent of one afternoon a week in the steam laboratory, where practice is had in operating and indicating engines; measuring chimney draft, boiler evaporation and the calorific value of fuels. Junior year, second term five times a week. Laboratory, one afternoon a week.

7. *Dynamo Machinery.*—During the third term the Juniors meet three times a week for discussion of direct current dynamos and motors. This course includes a discussion of the magnetic circuit of dynamos and motors, with methods of connecting for operation in series and parallel; characteristic curves, methods of testing dynamos and motors, etc.

8. *Alternating Current Machinery.*—The Seniors meet five times a week during the first term for the study of alternating currents and alternating current machinery. Typical single and polyphase generators, synchronous and induction motors, stationary and rotary transformers, are studied; and the effect of frequency, induction and capacity upon the impedance of the circuit are studied by the graphical and analytical solution of numerous problems in transmission and distribution.

9. *Electrical Transmission.*—During the latter part of the first term the class in alternate current machinery begins the study of the electrical transmission of energy and continues this subject three times a week during the second term. The course includes the continuous circuit, single and polyphase alternating current transmission, series and parallel distribution, design of the conducting system, overhead and underground construction, etc. Lectures and recitations supplemented by one afternoon per week devoted to working out electrical problems.

10. *Dynamo Laboratory.*—The work in the dynamo laboratory is begun in the third term of the Junior year and continued two afternoons a week during the first term of the Senior year. The work includes calibration of instruments, characteristic curves, efficiency tests of dynamos, motors, transformers, etc., line resistance, capacity, inductance, impedance and insulation measurements.

Laboratory Text-Books.—Stewart & Gee, Vol. I, Elementary Practical Physics, and Vol. II, Electricity and Magnetism; E. L. Nichols, Laboratory Manual, Vol. I and Vol. II; Kohlrausch, Physical Measurements; Carhart & Patterson, Electrical Measurements; Ostwald, Physico-Chemical Measurements.

ELECTIVE WORK.

12. *Theory of Electricity and Magnetism.*—A mathematical treatment of the subject. Three hours a week during the first and second terms. Open to graduates and to advanced undergraduates.

Text-Book.—Electricity and Magnetism, by F. E. Nipher.

13. *Alternating Currents.*—An analytical and geometrical treatment of the subject. Two hours a week during the first and second terms. Open to graduates and to advanced undergraduates.

VIEW ON CAMPUS.

14. *Dynamo Design.*—This course includes the design of dynamos, motors, alternators and transformers. Three afternoons per week during the third term. Open to those who have completed courses 8 and 9.

DEPARTMENT OF CIVIL ENGINEERING.

PROFS. HARRIS AND MESSRS. CLARKE, BARTLETT, PERKINS, WRIGHT.

1. *Surveying.*—The Sophomore work consists of a course in general surveying, including the use of the transit, the level and the solar compass. Areas surveyed are required to be plotted to scale and the drawing completely finished in all its details. Following this work city surveying, topographic methods and mine surveying are taught. First term, five times a week.

1a. *Field Practice.*—The Sophomore students have field practice two afternoons a week. This is supplmentary to the text-book work.

1*b*. *Topography.*—Between the second and third terms, sophomore year, one week is given to field work in Topographic Surveying. The students are divided into parties, each with a captain, and to each is assigned an area to be covered. From notes so taken the Junior Civil Engineering students are required to produce a finished topographic map.

1*c*. *Geodesy.*—In this course the student is taken into the higher problems in surveying, including Engineering Astronomy, Base Line Measurments and Precise Leveling. Sophomore Civil Engineering course, second term, three times a week.

1*d*. *Geodesy, Computations and Drawings.*—In this course the student is exercised in mapping and platting in the determination of areas and partition of land, and learns to systematically work up the problems in geodesy. Sophomore (C. E.) year, second term, three afternoons per week.

2. *Lines of Communication.*—This course covers the mathematical problems in the location of railways, highways and canals, and in setting out and estimating earthwork, laying out track, locating tunnels, etc. The text-book is supplemented by field practice one afternoon a week for students in Mine Engineering, and three afternoons for those in Civil Engineering. Sophomore, third term, three recitations a week.

3. *Railway Economics.*—This course treats of the economic principles of railway location and improvements of old lines as affected by curvature, grades, first cost, cost of maintenance and traffic. Junior (C. E.) year, third term, two times per week.

4. *Masonry Construction.*—The course treats of the economic properties of building stone, brick and cements; the proportioning, mixing and placing of mortars and concrete; preparation of foundations and strength and stability of masonry structures, including dams, piers, abutments, retaining walls and arches. Juniors, first term, two times a week.

4*a*. *Cements and Concretes.*—In addition to laboratory work in other departments, students make the standard tests of cements and determine the most economic proportions for concrete of various qualities of sand, gravel and broken stone. Junior (C. E.) year, first term, one afternoon per week.

5. *Roads and Pavements.*—A course discussing the principles involved in the location and construction of highways, street and roads, and the merits of the various methods of paving. Juniors, in Civil Engineering, third term, three times per week.

6. *Masonry Designs and Concrete Steel.*—This course treats of the higher structures in masonry, including arches, dams, portals, etc., and the art and theory of "concrete steel" structures. The student is required to prepare drawings and

specifications of as many such structures as the time available will permit. Senior (C. E.) year third term two times per week.

7. *Hydraulics.*—A course covering the theory of Hydrastics and of Hydraulics; determination of experimental coefficients and their use as applied to the flow of water through orifices, weirs, pipes and canals. Also the theory of hydraulic motors and dynamic pumps. Juniors, third term, five times a week.

8. *Water Supply.*—A course covering the selection, imponding, transporting and delivering of a water supply to cities and towns. Senior (C. E.) year first term, five times per week.

9. *Sanitary Engineering.*—A course treating of the necessary precautions for the protection of water supplies from pollution and the methods available for the purification of contaminated supplies; the principles involved in the collection and disposal of sewage and storm waters. Seniors, (C. E.) second term, five times a week.

10. *Irrigation.*—A short course designed to bring out the essential details of the location of canals, headworks, impounding reservoirs, and supplementary work. Seniors, third term, three times per week.

11. *River and Harbor Improvements.*—A course treating of the control of flood water, protection of river banks, improvement of navigation and protection and improvement of harbors. Seniors (C. E.) third term, two times per week.

12. *Frame Structures.*—This course, designed alike for students in Mining and Civil Engineering, treats of general methods of determining stresses in such structures as single span bridges, roof trusses, towers, derricks and of the design of individual members, as posts, beams and rods, to carry specified stresses. Seniors, first term, five times a week.

13. *Bridges (Higher Structures).*—This course is for students in Civil Engineering only and carries them into the study of arches, cantelever, swing and suspension bridges. Senior Civil Engineering, second term, five times a week.

14. *Drawing and Graphics.*—Students in Civil Engineering are required to complete a topographic map during the Junior year. He is further exercised in the elementary problems of graphic statics as applied to single-span bridges and roofs and to masonry structures. Junior Civil Engineering students, first term, two afternoons; second and third terms, one afternoon.

15. *Engineering Designs.*—The Senior students in Civil Engineering devotes five afternoons a week during the first and second term to designs in some line of engineering, such as steel bridges, concrete steel structures, water supplies, sewage systems or the like.

16. *Special Investigations (Thesis).*—In the third term Senior year all graduating students give five afternoons a week to original investigation in some subject which they select, with the approval of the faculty.

17. *Compressed Air.*—A course covering the laws governing the compression and piping of air and the application of compressed air to the industries. Seniors, second term, twice a week.

18. *Contracts and Specifications.*—A course covering the general principles involved in the drawing up of contracts, and the preparation of specifications for the control and guidance of contractors and engineers. Seniors, third term, twice a week.

19. *Astronomy.*—A course in general astronomy for students in Civil Engineering. Second term, twice a week.

DEPARTMENT OF MINING ENGINEERING.

PROF. DRAPER.

1. *Ore Dressing.*—A course on the principles, methods and mechanical appliances in use to-day for crushing, classifi-

ORE DRESSING BUILDING.

cation and concentration of all important ores, including magnetic separation; preparation of coal.

Text-Book.—Richards' Ore Dressing.

Juniors, E. M. and C. & M. courses, first and second terms, three times per week.

1a. *Ore Dressing Laboratory.* The object is to give the student experience in the more common methods of ore dressing, treated in the theoretical discussions, and to afford him practice in the application of principles to the production of useful results.

Juniors, E. M. and C. and M. courses, first term, Saturday forenoons.

2. *Mining.*—Lectures on Prospecting, Drilling and Wellboring, Exploitation, Blasting, Haulage, Hoisting, Drainage, Ventilation, Lighting, Accidents, Hygiene, Mining Law, Sampling, Examination and Valuation of Mines, and Quarrying. Practical problems, projects and reports on visits of inspection, constitute features of the course. An excursion is taken to a mining district at end of second term. Seniors, second and third terms, three hours per week.

3. *Mine Surveying.*—Some additional matter, such as methods adapted to special cases, with problems involving the principal conditions encountered in mine surveying are included in the course in Mining. The subject of Mine Surveying constitutes part of the regular course in surveying. An excursion to the Joplin district for mine surveying is a part of the work, Junior year.

4. *Mill Design.*—Involves the designing, making of specifications, and execution of working drawings of concentrating mills. Seniors, E. M. and C. & M. courses, first term, two afternoons per week.

5. *Mining Problems.*—Problems in connection with the design of mining plants, as for hoisting, drainage, ventilation, transportation, etc.

Seniors, E. M. course, second and third terms, one afternoon per week.

DEPARTMENT OF GEOLOGY AND MINERALOGY.

PROFS. LADD, GRISWOLD, DRAPER AND MR. WILSON.

Lectures and laboratory work supplemented by excursions in the field make up the courses in this department, which are as follows:

1. *Crystallography.*—This is taught as an introduction to the course of Mineralogy, and consists of lectures on the general principles of the subject, with a careful study of the forms of different systems, and the different methods of notation. The study of models, drawings and natural crystals constitute an important part of the course. Sophomores, second term, as a part of Mineralogy.

2. *Mineralogy.*—This course consists of lectures and laboratory work. It involves the study of the important metaliferous and rock-forming minerals. Blow-pipe determination is made use of, though the student is taught, as far as possible, to recognize the minerals through their various characteristics without the use of qualitative analysis and blow-pipe work. Moses' Mineralogy and Blow-pipe Analysis, or Dana's Text-Book of Mineralogy may be used as a text. Sophomores, 2nd and 3rd terms, two afternoons per week.

3. *General Geology.*—This is a lecture course devoted to the principles of general and economic geology. It discusses the evolution of the earth, its present condition, and the processes which have modified its crust and surface. This course is closed with a discussion of the general features of the geology of the United States.

4. *General Geology Laboratory.—Lithology.*— The practical determination of rocks is treated as a continuation of mineralogy, and this course includes the microscopic study of

rock-making minerals and rocks; the use of microscopic study of rocks is illustrated, and the preparation by the student of thin rock section is taught. Fall term.

Structural Geology.—The student has work upon geological models, maps, and photographs with the view to interpreting geological structures and land surface forms. Winter term.

Field Work.—The student visits various localities near Rolla with the instructor and has the various types of geology explained; then is assigned an area to map geologically. Spring term.

The course is supplemented by the summer field excursions to southeast and southwest Missouri.

5. *Economic Geology.*—This is a series of lectures dealing with the occurrence, origin and distribution of ores, clays, building stones, gems, water supply and other products of economic value from the different geological formations. The characteristics and genesis of ore deposits are carefully considered. The members of this class visit locations near Rolla of economic importance, studying iron, lead, coal, clay, buildstones, etc., besides making an excursion to the zinc-lead district of Joplin. The use of Ries' Economic Geology of the United States is required of the student. Seniors, twice a week, first and second terms, and five times a week, third term.

DEPARTMENT OF METALLURGY.

PROF. PACKARD, MR. SELTZER AND MR. WASH.

The work in this department is designed to give students a thorough training in all branches of Metallurgy.

It is recognized that a school cannot give students, in the brief time at its disposal, that skill which comes from long practice, but it is the aim of the department to give such training in the fundamental principles and their application, that students may become useful immediately on their entrance into the

actual practice of their chosen profession. All metallurgical courses are accompanied by graded metallurgical problems, which give the student a technical command of the subject.

An important feature of the instruction in this department is experimental investigation in the metallurgical treatment of various ores.

For convenience in recording and reporting, the subjects following are classified under the general letter M, with necessary subdivisions.

M.—1. *Fire-Assaying.*—Scorification and crucible assays of gold and silver ores,assays of copper mattes, corrected assays, assay of bullion, fire-assay of lead ores.

The laboratory course is supplemented by lectures. The nature of the processes is thoroughly explained and practical difficulties discussed. Three afternoons per week, second term, Junior year. Lectures two hours per week.

Text-Book.—Lodge's "Notes on Assaying."

Quantitative Analysis required.

M.—2. *General Metallurgy and Metallurgy of Iron.*—Begins with general principles, including properties of metals and alloys, fuels, fluxees, calculation of charges, general study and classification of furnaces, followed by a study of processes employed for the production of cast iron, wrought iron and steel.

Text.—Hofman's "Notes on Steel."

Reference Books.—Roberts-Austin's Introduction; Howe's Metallurgy of Steel; Campbell's Steel.

Juniors, third term, five hours per week. The Seniors of the C. E. course are given special work.

M.—3. *Metallurgy of Lead and Silver.*—Lectures and recitations.

Hofman's Metallurgy is used as a test for lead and desilverization of base bullion, and Collins' Metallurgy of Silver for wet processes of silver extraction.

Seniors, first term, five hours per week.

MECHANICAL HALL.

M.—4. *Metallurgy of Copper, Nickel, Mercury, Tin, Antimony.*—Peter's Metallurgy of Copper is used as a reference book and is followed by lectures on the other metals named, with Schnabel's Metallurgy for reference.

Seniors, second term, four hours per week.

M.—5. *Metallurgy of Gold and Zinc.*—Lectures and recitations.

Text-Book.—Rose's Metallurgy of Gold. For reference on zinc, Ingall's Metallurgy of Zinc and Cadmium.

Seniors, third term, four hours per week.

M.—6. *Constitution of Alloys.*—Lectures dealing with the theoretical and practical considerations that influence the structure and properties of alloys of different types..

Juniors C. Met. course two hours per week, second term.

M.—7. *Electrometallurgy.*—To follow courses.

Lectures are given covering the Electrometallurgical processes that are in use. Efficiency and Engineering calculations based on this and the preceding required courses above mentioned.

Seniors Met. course, first term, 2 hours per week, and one afternoon of laboratory work.

Text-Book.— Borcher's Electrometallurgy and current literature on the subject.

M.—8 *Metallurgical Organization.*—The course briefly takes up the principles of organization, and the duties of officers and accounting force of a Metallurgical plant. The outline shows the extent of the course. Organization of companies and working forces, management, superintendence, skilled and unskilled labor. Then following this, the constitution of capital; stocks, bonds, dividends and profits.

Seniors, Met. course, second term, four hours per week.

Text-Book.—Conyngton on Corporation Management.

M.—9. *Metallurgical Accounting.*—Covers the bookkeeping and accounting necessary in a Metallurgical works. It deals with costs and expenses of operation, or ore supply, fuel,

fluxes, by products and markets, and in addition, sinking funds, insurance, deterioration and repairs, interest, balance sheets and annual statements.

Seniors, Met. course, second term, 3 hours per week lectures, and one afternoon practice work.

M.—10. *Metallurgical Problems.*—These problems aim to cover the common ones that the Metallurgist meets in practicing his profession. They are carefully chosen so as to represent as typical cases as possible.

Seniors, Met. course, 4 hours per week, third term.

Prof. J. W. Richard's "Metallurgical Problems" will be used as a text.

M.—11. *Memoirs.*—The student in the Met. course is required to do a considerable amount of technical reading in German and English. Carefully prepared abstracts of valuable current articles are presented and read by the students themselves. These articles are chosen by reason of having special value along Chemical or Metallurgical lines.

Report days, one hour per week, first and third terms.

Seniors Met. course.

M.—12. *Conference.*—Laboratory course, M.—14 is accompanied by weekly conferences. These are of great value to the student, and aid him materially in getting the full value from his laboratory work.

LABORATORY WORK.

M.—13. *Metallurgical Laboratory.*—This course aims to familiarize the student with the use of calorimeters and pyrometers, and their calibration. Some insight is given into the ordinary methods of Metallurgical investigation, and the methods of measurement, that a Metallurgist should know how to conduct.

Juniors, Met, course, third term, one afternoon.

Text-Book.— Howe's Laboratory Notes.

M.—14. *Metallurgical Laboratory.* — Test of ores by cyaniding, chlorination, amalgamation, lixiviation, roastng in reverberatory and smelting in the blast furnace.

Howe's Metallurgical Laboratory Notes and Lodges Assaying are used as laboratory manuals.

Seniors first and second terms, Saturdays. M. E. & Met. courses.

Weekly conference, one hour per week.

To be preceded by M.—1.

M.—15. *Metallography.*—Study of the microstructure and of iron and steel and the effects of heat treatment.

Seniors M. E. course, second term, 1 afternoon per week.

M.—16. *Metallography*—Similar to M—15, but covering more ground and including some special experimental work. To be preceded by M.—G.

Seniors, Met. course, second term, 2 afternoons per week.

M.—17. *Metallurgical or Electrometallurgical Designing.*—This work has special reference to the designing and proportioning of various types of furnaces for special duties and conditions. It will call for a clear conception of Metallurgical principles.

The alternative, Electrometallurgical Designing, will cover the design and estimates for a copper or copper-nickel refinery.

Seniors Met. course, third term, 2 afternoons per week.

DRAWING AND DESIGNING.

Mechanical Drawing.—The student is first given practice in geometrical construction until he is familiar with the nature, care and use of drafting instruments. Then, after carefully studying the principles of orthographic projection, intersection and development, he is thoroughly drilled in free hand lettering. The course is completed with one term of machine

drawing. In this the student is required to make sketches, detail and assembly drawings of machines, and is taught the principles of elementary machine design.

Freshmen year, six hours per week throughout the year.

Text-Books.—Anthony's Mechanical Drawing, Wilson's Free Hand Lettering and Anthony's Machine Drawing.

PROF. BOWEN AND MR. SMITH.

Descriptive Geometry.—The usual text-book work is reinforced with daily blackboard exercises in presenting the projections of familiar objects, intersections of plane and curved surfaces, sections, developments, etc. The work includes perspective and shades and shadows. The afternoons in the drawing room are devoted to the solution, in neat form, of the more elaborate exercises. Freshman year second and third terms six hours per week, consisting of two half hour recitations and two and a half hour periods in the drawing room. PROFESSOR L. E. GARRETT.

Drawing and Graphics.—The student is exercised in elementary problems in graphic statics as applied to single span bridges and roof trusses and to masonry structures.

Junior year, E. M. course, one afternoon per week second and third term; C. E. course two afternoons a week throughout the year. PROFESSOR HARRIS AND MR. CLARKE.

Topography Map.—The Juniors in the C. E. course are required to make a complete topographic map from the data obtained by the sophomore class in topography.

PROFESSOR HARRIS AND MR. CLARKE.

Engineering Designs.—The Senior students in Civil Engineering devotes five afternoons a week during the first and second term to designs in some line of engineering such as steel bridges, concrete steel structures, water supplies, sewage systems or the like. PROFESSOR HARRIS.

Mill Design.—Involves the designing, making of specifications and execution of working drawings of concentrating mills. Seniors, E. M. course, first term, two afternoons per week. PROFESSOR DRAPER.

VIEW IN LATHE ROOM.

Mining Design.—A Similar course in the design of mining plants as for hoisting, draining, ventilation or transportation, etc. Seniors, E. M. course second and third terms, one afternoon per week. PROFESSOR DRAPER.

Metallurgy Design.—This work has reference to the designing and proportioning of various types of furnaces for special duties and conditions. It will call for a clear conception of metallurgical principles. An alternative in Electrometallurgy design will cover the design and estimates for a copper or a copper-nickel refinery.

Seniors metallurgy course, third term, two afternoons per week. PROFESSOR W. W. GARRETT.

SHOP PRACTICE.

PROF. BOWEN AND MR. SMITH.

1. *Wood Work.*—The work in this course begins with simple exercises in planing and marking with the gage and knife. It continues until the pupil has become thoroughly familiar with the use of the plane, bevel, square, gage and knife. He is then given graded exercises covering rip and cross-cut sawing and sawing to a "fit." Following this comes work at joints designed to show the different methods of construction, glue joints, doweling, dove tails and braces. This work is supplemented by talks on the tools and work in hand, and each student is required to pass a written examination on notes covering the classification and use of hand tools and accessories.

Wood turning follows the above work, and is designed to familiarize the student with the use of the lathe. He is given graded exercises, beginning with a plane cylinder, embracing curves of various kinds and sizes, and ending with face plate work in rings, balls, goblets, vases, etc. On all the preliminary work students are required to use the tools in such a way as to make the use of sand paper unnecessary.

A final part of this course is cabinet making, designed to give the student work on the planer, scroll-saw, mortise ma-

chine, etc. After becoming familiar with the different machines pattern-making is begun. The purpose of this work being to teach the student to make representative types of patterns from which castings may be made. The principles of the shrink rule are explained and drawings, such as are used in manufacturing plants, are made in order to teach the use of the finish marks, core boxes, and all conventional signs.

All work is done from drawings.

Freshman class, two afternoons per week the first and second terms and one afternoon per week the third term.

2. *Forge Work.*—This course begins with simple exercises in drawing, upsetting, bending, twisting, punching and welding. The work gradually becomes more difficult, such as making eye bolts, chains, tongs, etc., followed by ornamental work, in making benches, umbrella racks, waste baskets, etc. Tool making is then begun by making screw drivers, hammers, chisels, and a complete set of lathe tools, which will be used later in the machine shop. This work is fully illustrated by drawings and lectures on the subject, covering the properties of the different grades of iron and steel. Great care is exercised to make the student familiar with the best grade of steel to be used for any required purpose, and the correct shape and temper necessary for the best work in cutting iron, steel, brass, stone etc. Sophomore class, first and second terms two afternoons per week.

4. *Metal Work.*—This course begins with chipping to a line, filing to a dimension and scraping to a surface plate. Machine operation is then begun, the principles and uses of the drill-press, lathe, planer, shaper and milling machine are taught by lectures followed by practical work at each machine. After a reasonable time skill is attained in operating the various machines through a course of graded exercises. Students are required to build complete machines designed by upper classmen or by the instructor. In this work use is made of the vernier micrometer, thread micrometer and gear-tooth calliper. The degree of accuracy thus acquired enables the student to use eye and hand in unison, and is a lasting benefit in teaching exactness in statement and measurement.

Sophomore class, second term one afternoon per week.

While this department contains the best of tools and machinery the effort is constantly made to encourage the student to use his judgment in developing new ideas and improving on existing methods.

ENGLISH.

MR. SCOTT.

There is a growing appreciation of the value, in practical affairs, of the ability to use language with ease, clearness and forcefulness. The importance of English composition as a mental gymnastics is being acknowledged as never before, and, more and more, instructors in technical schools are recognizing the fact that it is an essential part of an engineer's education.

1. *Theme Work.*—All freshman in this Institution are required to write, throughout the year, short, daily, and long fortnightly themes. This work is carefully criticised by the instructor, corrected by the student and returned to the former as evidence that the student has profited by the criticisms.

2. *Rhetoric.*—Lectures and Recitations. This work is designed as a continuation of the subject as taught in the high schools of the State. Freshman, sections A. and B. five times a week throughout the year.

Text-Books.—Brewster's "Representative Essays on the Theory of Style," and Baldwin's College Manual of Rhetoric.

3. *Advanced English.*—All sophomores will be required to study masterpieces throughout the year, and in connection therewith to write two themes a month of not less than four hundred words each. The plan for the criticism of these themes is the same as that used in the freshman work. A complete outline of the work will be given the class at the beginning of the fall term.

Students in this work will attend one lecture a week.

MODERN LANGUAGES.

MR. WILKINS.

The great quantity and worth of the technical literature in the French and German languages, added to their value as elements of liberal culture, make at least a reading knowledge of them practically a necessary part of an engineer's education.

The instruction in each language is designed to present the grammatical structure and the pronunciation of the tongue, to give some acquaintance with the masterpieces of its literature, and to confer such facility in translation as will enable the student to read with ease the language in both its literary and its scientific uses.

German.—(Elementary, for such students who elect German as the foreign language in their course, and who have not had at least *one year* of High School German.)

Keyser and Monteso's German Grammar.

Four times per week throughout Second and Third terms of the Freshman year.

German (Scientific).—Dippold's Scientific German Reader current scientific journals and magazines.

Five times per week throughout Sophomore year.

French (Scientific).—Herdler's Scientific French Reader, current scientific journals and magazines.

Five times per week throughout Sophomore year.

Students who have not had Elementary French will not be permitted to elect this language.

Spanish.—The growing demand for Mining Engineers and Metallurgists in South and Central America, in Mexico and the Philippines, where a knowledge of Spanish is almost an essential qualification, has been met by the establishment of a course in this language in the School of Mines. The natural or conversational method is followed exclusively

Hills and Ford's Spanish Grammar, and lectures.

The object is to give the student facility in the every-day speech of the people.

Five times per week throughout the Sophomore year.

With the consent of the faculty, students may elect Spanish as the required modern language.

VIEW ON CAMPUS.

GENERAL INFORMATION.

TERMS AND VACATIONS.

The college year, consisting of 38 weeks, exclusive of the Christmas holidays, is divided into three terms; the first beginning September 18th, and ending with the Christmas holidays; the second beginning January 2nd, and extending to the 18th of March; and the third beginning on the 18th, of March and closing the 2d Wednesday in June. The Christmas holidays cover ten days, and intervene between the first and second term. There is no interruption of work between the second and the third terms. Thanksgiving Day and Washington's Birthday are observed as single holidays. In the month of March a week is set aside for field excursions for practice in engineering or geology and for visits of inspection to mines and metallurgical works.

EXCURSIONS.*

During the past year the students of the Senior Class made an excursion to St. Louis, Granite City, Ill., and to Southeast Missouri. At St. Louis the methods of smelting zinc ores; of smelting and refining lead ores, when accompanied by silver; and of the manufacture of steel by the basic open hearth process, were studied. In the lead-producing portion of Southeastern Missouri, the mines and mill of the St. Joseph Lead Company, at Bonne Terre and Doe Run; of the Desloge Lead Co., at Desloge, and of the Central Lead Co., at Flat River, were visited, where a careful study was made of the methods of concentration of galena ores by both the English and Continental systems. The students in Mining Engineering were also enabled to make a careful study of the methods of mining. The roasting and reduction of lead ores and refining of the bullion were seen at Herculaneum, as well as the places mentioned above. Excursions were also made by this class to the iron mines of Dent and Phelps counties.

The summer excursion of the junior class covers a period of four weeks, beginning the day after commencement, and includes a study of field geology, mining, mine surveying and ore dressing plants.

Last year the class was first taken in charge by the professors of geology and mining, and began with a study of the

*See also page 31.

carboniferous basin about St. Louis, and of its relation to the Illinois coal fields; the economic uses of the carboniferous clays in the clay industries were incidentally noted. Later the Iron Mountain vicinity was visited, and the relations of the palezoic sedimentaries to the pre-cambrian igneous masses of the St. Francois Mountains, were brough out, and the iron deposits of the igneous masses examined in detail.

In the southeastern lead section the system of mining the disseminated ores which occur there was observed, and some of the best mining and ore dressing plants studied, including steam and electric hoisting plants, with modern steel head-frames, underground haulage, with compressed air locomotives, pumping equipments, and a number of well designed modern concentrating mills, both electric and steam. Prospecting with the diamond-drill was here observed, both from the surface and underground.

The class was then taken to the Joplin district, where the systems of mining the zinc and lead ores in the different kinds of ground there occurring, were studied, from the hard "sheet ground" to the soft ground requiring fore-poling. The milling practice of the district was carefully studied in some of the typical mills.

The professor of surveying then took charge and the class was given ten days' practice in mine surveying and platting. A complete survey and map of Troup Mine No. 4 was made.

The Spring River Power Co.'s fine water power electric and auxiliary steam, electric plants were inspected.

As heretofore, most courteous treatment was extended by owners and managers.

Five students accompanied the professor of geology during the Christmas holidays to the fluorite mines near Rosedale, Ill., where fissure veins and igueous phenomena were studied, as well as minerals and fossils. Then the party proceeded to Birmingham and Talladega, Alabama, investigating iron, coal, flux, and marble, both in regard to field occurrence and utilization in the arts; metamorphism in the crystallines near Talladega as well as structures in the plaeozoics about Birmingham were fruitful subjects of study.

A trip was also made to the Joplin district, for the purpose of examining and surveying zinc mines.

At the close of the second term the sophomore class made a week's excursion to the Gasconade river for field work in Surveying, and Lines of Communication.

A trip was made by the Junior Class to the coal fields of Illinois and to Southeast Missouri for the study of the Iron Mountain and Pilot Knob iron mines, and of the igneous rocks of that region.

Similar excursions, as outlined on another page, will be required as a regular part of the student's work in the future.

EXPENSES.†

Laboratory Fees.—The Board of Curators, at a meeting held in December, 1898, voted to make tuition free, and to abolish the entrance fees which have hitherto been charged. The fixed charges remaining are: A library fee of $5 per year, payable upon entrance; a laboratory fee to cover the cost of gas and supplies, amounting to $10.00 for the Course in General Chemistry; a laboratory fee of $15.00, to cover the cost of general supplies, gas, etc., for the course in Qualitative Analysis; a fee for Seniors and Juniors taking chemical laboratory work, of $3.50; a fee for the course in Shop Work, to cover the cost of supplies, of $5.00; a fee for the course in Forge work, to cover the cost of supplies, $5.00; a general fee, to cover the cost of supplies, for students taking Assaying, of $25; a fee, for students taking Mineralogy, to cover the cost of supplies, of $8; and a fee of $5 for students in senior Metallurgy.

The above charges are made on the basis of the actual average cost per student for supplies in the respective courses, at wholesale rates.

Excursion Expenses.—The cost of field excursions will average about $35 per year.

Contingent Deposits.—Deposits, to cover the cost of extra supplies, damage to apparatus, etc., are required of the different classmen as follows: Freshmen, $10; Sophomores, Juniors and Seniors, $15. These deposits must be renewed if at any time exhausted, and at the end of the school year whatever sum may remain to the credit of the depositor is returned to him.

No distinction, in admission or charges, is made between residents of this State and those of any other State or country.

---

†See also Athletics.

Living Expenses.—Board, including lodging, meals, fuel and lighting, may be had in private residences or at hotels for from $18.00 to $20.00 per month.

The expenses of many students for the entire school year do not exceed $225.00, and $275.00 will cover, in a reasonable manner, the fees, and the cost of books, stationery, board, lodging, fuel, lights and washing. The cost of field excursions is not included in the above estimate.

ATHLETICS.

The School encourages rational athletics. Occasional privileges are granted to athletic teams, but prolonged absences from work are not permitted.

An athletic field has been enclosed and graded for baseball, football, etc., and an ample number of tennis courts have been laid out, and are maintained in good order. A general athletic association exists among the students, also football and baseball teams, and a tennis club.

Athletic Fee.—Each student is requested to pay a fee of $5.00 to the Athletic Association of the school.

SOCIETIES.

The following chapters of college fraternities exist at the School: Gamma Chi of Sigma Nu, Beta Alpha of Kappa Alpha, and Beta Chi of Kappa Sigma, Alpha Kappa of Pi Kappa Alpha.

The Young Men's Christian Association was organized in the College several years ago, and is growing rapidly.

It stands for the best there is in college life and brings together those who believe that college men should develop well rounded characters, physical, mental and spiritual.

During the opening days of the college, trains will be met by association members, who place themselves at the service of new men, helping them to secure rooms and board to matriculate, etc.

The Association occupies the second floor of the Metallurgy building, where all students are welcomed.

BUREAU OF GEOLOGY AND MINES.

The Geological Survey of the State of Missouri has its headquarters at the School of Mines in accordance with the following statute:

FORGE ROOM.

SECTION 1. That section 7502 of chapter 110, Revised Statutes of 1899, be and the same is hereby amended by striking out the words "and who is not connected with any school or college as an instructor," after the word "mineralogy," in the fourth line of said section and inserting in lieu thereof the words "and whose headquarters shall be located at the State School of Mines at Rolla," so that said section, when thus amended shall read as follows:

SECTION 7502. The Board of Managers are authorized, as soon as they are organized, to appoint one State Geologist, who shall be a person of competent scientific and practical knowledge of the science of geology and mineralogy, and whose headquarters shall be located at the State School of Mines at Rolla, who shall be the director of the survey, and said State Geologist may appoint such assistants and subordinate assistants and laborers as may be deemed necessary in order to make a thorough scientific, geological and mineralogical survey of the state.

SEC. 2. That a new section be enacted to be known as section 7502a, to read as follows:

SECTION 7502a. The Board of Managers of the bureau of geology and mines are hereby authorized and directed to transfer all instruments, books, charts, cabinet collections and other property of the State of Missouri now under the control of said board to the State School of Mines at Rolla and to establish the headquarters of the geological survey at said State School of Mines.

BOARD OF MANAGERS.

Governor Joseph W. Folk, ex-officio; Prof. E. M. Shepard, Springfield; Elias S. Gatch, St. Louis, Stonewall Pritchett, Webb City, L. T. Cottey, Edina. Terms expire May 22, 1909.

OFFICERS OF THE GEOLOGICAL SURVEY.

E. R. Buckley, Ph. D., State Geologist.
H. A. Buehler, A. B., Assistant Geologist and Chemist.
Miss Lena Strobach, Stenographer.

EQUIPMENT.

The Bureau occupies the east half of the Rolla Building, and is furnished heat and light by the school.

The Survey has under its control at the present time a library of 4000 books and pamphlets bearing on geological subjects, and a museum collection of nearly 6000 specimens of the various clays, coals, fossils, and other geological products of the State.

FRESHMAN SCHEDULE.

HOURS	TERM.	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
8-11	1st	Shop Pr. (A)	Shop Pr. (A)	Mech. Dr. (A)	Mech. Dr. (A)	Chemistry (A)	
	2nd	Shop Pr. (A)	Shop Pr. (A)	Mech. Dr. (A)	Mech. Dr. (A)	Chemistry (A)	Desc. Geom.
	3rd	Shop Pr. (A)		Mech. Dr. (A)	Mech. Dr. (A)	Chemistry (A)	Desc. Geom.
8-9	1st	Higher Alg. (B)	Higher Alg. (B)	Higher Alg. (B)	Higher Alg. (B)	Higher Alg. (B)	
	2nd	Trigonometry(B)	Trig. (B)	Trig. (B)	Trig. (B)	Trig. (B)	
	3rd	Anal. Geom. (B)	Anal. Geom. (B)	Anal. Geom. (B)	Anal .Geom. (B)	Anal. Geom. (B)	
9-10	1st	English (B)	English (B)	English (B)	English (B)	English (B)	
	2nd	English (B)	English (B)	English (B)	English (B)	English (B)	
	3rd	English (B)	English (B)	English (B)	English (B)	English (B)	
10-11	1st	Solid Geom. (B)		Solid Geom. (B)		Solid Geom. (B)	
	2nd						
	3rd						
11-12	1st	Gen'l Chem.	Gen'l Chem.	Gen'l Chem.	Gen'l Chem.	Gen'l Chem.	
	2nd	Gen'l Chem.	Gen'l Chem.	Gen'l Chem.	Gen'l Chem.	Gen'l Chem.	
	3rd	Gen'l Chem.	Gen'l Chem.	Gen'l Chem.	Gen'l Chem.	Gen'l Chem.	
1-4	1st	Mech. Dr. (B)	Mech. Dr.	Shop Pr. (B)	Shop Pr. (B)	Chem. (B)	
	2nd	Mech. Dr. (B)	Mech. Dr. (B)	Shop Pr. (B)	Shop Pr. (B)	Chem. (B)	Desc. Geom.
	3rd	Mech. Dr. (B)	Mech. Dr. (B)	Shop Pr. (B)	Desc. Geom.	Chem. (B)	
1-2	1st	Higher Alg. (A)	Higher Alg. (A)	Higher Alg. (A)	Higher Alg. (A)	Higher Alg. (A)	
	2nd	Trigonometry(A)	Trig. (A)	Trig. (A)	Trig. (A)	Trig. (A)	
	3rd	Anal. Geom (A)	Anal. Geom. (A)	Anal. Geom. (A)	Anal. Geom. (A)	Anal. Geom. (A)	
2-3	1st	English (A)	English (A)	English (A)	English (A)	English (A)	
	2nd	English (A)	English (A)	English (A)	English (A)	English (A)	
	3rd	English (A)	English (A)	English (A)	English (A)	English (A)	
3-4	1st	Solid Geom. (A)		Solid Geom. (A)		Solid Geom. (A)	
	2nd						
	3rd						

SOPHOMORE SCHEDULE.

HOURS	TERM	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
8-9	1st	Language	Language	Language	Language	Language	Surveying
	2nd	Language	Language	Language	Language	Language	Forge
	3rd	Language	Language	Language	Language	Language	Surveying
9-10	1st	Calculus	Calculus	Calculus	Calculus	Calculus	Surveying
	2nd	Calculus	Calculus	Calculus	Calculus	Calculus	Forge
	3rd	Calculus	Calculus	Calculus	Calculus	Calculus	Surveying
10-11	1st	Qual. Anal. Lec.					Surveying
	2nd	Qual. Anal. Lec.	Elem. Mech.		Elem. Mech.		Forge
	3rd	Lines Comm'n		Lines Comm'n		Lines Comm'n	Surveying
11-12	1st	Surveying	Surveying	Surveying	Surveying	Surveying	Surveying
	2nd	Crystallography		Crystallography		Crystallography	Forge
	3rd	Physics	Physics	Physics	Physics	Physics	Surveying
1-4	1st	Forge	Forge	Qual. Anal.	Qual. Anal.	Surveying	
	2nd	Machine Shop	Qual. Anal.	Qual. Anal.	Mineralogy	Mineralogy	Forge
	3rd	Surveying	Physics	Physics	Mineralogy	Mineralogy	

JUNIOR SCHEDULE.

HOURS	TERM	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
8-9	1st	Geology		Geology		Geology	Ore Dressing
	2nd	Geology		Geology		Geology	Quantitative Anal. Assaying
	3rd	Geology		Geology		Geology	Geology
9-10	1st	Ore Dressing	Masonry	Ore Dressing	Masonry	Ore Dressing	Ore Dressing
	2nd	Ore Dressing	Assaying	Ore Dressing	Assaying	Ore Dressing	Quant. Assaying
	3rd	Metallurgy	Metallurgy	Metallurgy-	Metallurgy	Metallurgy	Geology
10-11	1st	Physics	Physics	Physics	Physics	Physics	Ore Dressing
	2nd	Thermodynamics	Thermodynamics	Thermodynamics	Thermodynamics	Thermodynamics	Quant. Assaying
	3rd	Dynamos		Dynamos		Dynamos	Geology
11-12	1st	Mechanics	Mechanics	Mechanics	Mechanics	Mechanics	Ore Dressing
	2nd	Mech. Mat.	Mech. Mat.	Mech. Mat.	Mech. Mat.	Mech. Mat.	Quant. Assaying
	3rd	Hydraulics	Hydraulics	Hydraulics	Hydraulics	Hydraulics	Geology
1-4	1st	Quant. Analysis	Quant. Anal.	Quant. Anal. Geology	Physics	Physics	
	2nd	Steam Assaying	Quant. Anal.	Quant. Anal. and Geology.	Steam Assaying	Graphics	Quant. Assaying.
	3rd	Quantitative	Quantitative	Graphics	Dynamos	Dynamos	Geology
1-4	1st	Quant. Anal.	Quant. Anal.	Quant. Anal. and Geology	Physics.	Physics	
	2nd A	Steam	Quant. Anal.	Quant. Anal. and Geology	Assaying	Graphics	Assaying
	2nd B	Assaying	Assaying	Assaying	Steam	Graphics	Quant. Anal.
	3rd	Quant. Anal.	Quant. Anal.	Graphics	Dynamo	Dynamo	Geology

SENIOR SCHEDULE.

HOURS	TERM	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
8-9	1st	Metallurgy	Metallurgy	Metallurgy	Metallurgy	Metallurgy	Metallurgy Lab.
	2nd	Metallurgy	Metallurgy	Metallurgy	Metallurgy	Metallurgy	Metallurgy Lab.
	3rd	Metallurgy	Metallurgy	Metallurgy	Metallurgy	Metallurgy	Geol. Spec. Inv'n
9-10	1st	Frame Struct.	Frame Struct.	Frame Struct.	Frame Struct.	Frame Struct.	Metallurgy Lab.
	2nd			Metallurgy Conf.			
	3rd	Mining		Mining		Mining	Geol. Spec. Inv'n
10-11	1st		Econ. Geol.	Metallurgy Conf.	Econ. Geol.		Metallurgy Lab.
	2nd	Mining	Econ. Geol.	Mining	Econ. Geol.	Mining	Metallurgy Lab.
	3rd	Econ. Geol.	Econ. Geol.	Econ. Geol.	Econ. Geol.	Econ. Geol.	Geol. Spec. Inv'n
11-12	1st	Alternating Cur.	Alternating Cur.	Alternating Cur.	Alternating Cur.	Alternating Cur.	Metallurgy Lab.
	2nd	Elec. Trans.	Compressed Air	Elec. Trans.	Compressed Air	Elec. Trans.	Metallurgy Lab.
	3rd		Contracts etc.	Met. Conf..	Contracts etc.		Geol. Spec. Inv'n
1-4	1st	Alt. Currents	Alt. Currents	Graphics	Mill Design	Mill Design	Metallurgy Lab.
	2nd	Metallography	Metallography	Metallography & Design		Elec. Problems	Metallurgy Lab.
	3rd	Special Inv.	Special Inv.	Mining Design	Special Inv.	Special Inv.	Geol. Spec. Inv'n

CONFERRING OF DEGREES

ENGINEER OF MINES.

Raphael Currier Alexander.

METALLURGICAL ENGINEER.

Albert Dyke Wilson.

BACHELOR OF SCIENCE (MINE ENGINEERING.)

John Owen Ambler,
Robert Hardy Bedford,
John McMillen Brooks,
Damon Duffield Dunkin,
William Alexander Gardiner,
Cecil Theodore Green,
Walter Scott Grether,
William Thomas Griffith,
Edward Arthur Guntley,
Horace Alonzo Hand
Henry H. Hartzell,
Preston King Horner,
Frank Bowman Powell,
Ray Fleming Rucker,
John Dozier Shanks,
John Vivian Stevens,
Jesse Herman Steinmesch,
William Charles Wyman,

BACHELOR OF SCIENCE (CIVIL ENGINEERING.)

Robert Arthur Barton,
Mark Bernardi Burgher,
Tracy Irwin Phelps,
Ramon Rivera.

BACHELOR OF SCIENCE (CHEMISTRY AND METALLURGY.)

Damon Duffield Dunkin.

THESES

Utilization of the Verde River for Power Purposes,
RAPHAEL C. ALEXANDER, B. S.

Gas Manufacture at Laclede Gas Works, - ALBERT DYKE WILSON.

The Commercial Preparation of Baryta,
RAY F. RUCKER AND DAMON D. DUNKIN.

Plans and Estimates for the Disposal of Sewage and Storm Water for the City of Rolla,
TRACY IRVIN PHELPS AND ROBERT ARTHUR BARTON.

Efficiency of Air Lift Pumps,
MARK E. BURGHER AND DAMON D. DUNKIN.

Sewer System of Lebanon, Missouri, - - - RAMON RIVERA

Design of Reverberatory Matting Furnace,
JOHN M. BROOKS AND ROBERT H. BEDFORD.

Copper Matting Blast Furnace,
JOHN V. STEPHENS, FRANK B. POWELL AND JOHN D. SHANKS.

Design of Plant for Testing Tailings from Zinc Mill,
PRESTON K. HORNER AND EDWIN A. GUNTLEY.

Measurement of the Quantity of Water Delivered by Meramec Spring, - - - - - - - - JOHN OWEN AMBLER.

Special Investigations in Concrete-Steel, and Application of Same to Square Set System, - - - - HORACE A. HAND.

Analysis of Argillaceous Limestone and Shales,
HENRY H. HARTZELL.

The Investigation of the Deleterious Action of Certain Metals on the Cyanide Process for Gold,
LAMAR H. HUNT AND WILLIAM A. GARDINER.

Laboratory Tests and Design of Plant for Treating a Gold Ore,
JULIAN I. PRUGH AND WILLIAM C. WYMAN, JR.

Lead Blast Furnace Run,
JESSE H. STEINMESCH, CECIL T. GREEN AND WALTER S. GRETHER.

STUDENTS AT THE MISSOURI SCHOOL OF MINES.

1906 AND 1907.

GRADUATES.

Black, James Kennedy	Clayton, Mo.
Buskett, Evans	Coffeyville, Kan.
Dunkin, Dammon Duffield	Granby, Mo.
Green, Cecil Theodore	Los Angeles, Cal.
Heck, Elmer Cooper	Lathrop, Mo.
Hoffman, Ray Eugene	Buffalo, N. Y.
Moore, Stanley Ralston	Wallace, Idaho
Thomas, Alfred Agustus	Ketchican, Alaska

SENIORS.

Bailey, William Gardiner	Patterson, N. J.
Baker, Arnold George	St. Louis, Mo.
Bartlett, Albert Babbit	Cheyenne, Wyo.
Benedict, Ralph Robert	Kansas City, Mo.
Brown, William Ernest	Denver, Colo.
Cavazos, Enrique	Saltillo, Mexico
Clark, Horace Herbert	St. Louis, Mo.
Cook, Eldon Everett	Plattsburg, Mo.
Cook, Paul Richardson	Rolla, Mo.
DeWaters, Roy Hayward	Iola, Kansas
Ericson, John Theodore Emanuel	Kumla, Sweden
Fellows, Aubrey D.	Salisbury, Mo.
Hatch, William Peter	Kansas City, Mo.
Hughes, Victor Harmon	Sabetha, Kansas
Jones, Elston Everett	Albuquerque, New Mex.
Klockmann, Otto Ernest	St. Louis, Mo.
Ladd, Howard William	Ottumwa, Iowa
Long, James Carter	St. Louis, Mo.
McElroy, William	Ft. Scott, Kansas
McTighe, William Arthur	Memphis, Tenn.
Perkins, William Crutcher	Plattsburg, Mo.
Phillips, Walter Irving	Wheaton, Ill.
Richards, Walter Coffean	St. Louis, Mo.
Sebree, John Payne	LaJunta, Colo.
Seltzer, Andrew Jackson	Denver, Colo.
Snyder, Byron John	Desloge, Mo.
Sunada, Sakuhei	Yamanashi, Japan
Tseung, Tsik Chan (M. D. Oberlin)	Hunan, China
Vitt, John Thomas	Union, Mo.
Wash, Edwin Richard	Pontiac, Ill.
Wilson, Frank Lewis Leonard	DesMoines, Iowa
Wright, Ira Lee	Sedalia, Mo.
Zirulick, Hyman	Minsk, Russia

JUNIORS.

Anderson, Hector George Sylvester	Kearney, Neb.
Baker, Charles Armstrong	Fort Madison, Iowa
Barrett, Edward Phillip	Hastings, Neb.
Boland, Earl Frederick	Syracuse, N. Y.

BAND SAW IN SHOPS.

Bowles, John Hyer.....Lake Springs, Mo.
Boyer, George Hewitt.....St. Louis, Mo.
Cooke, Thomas Grant.....Mansfield, Ohio
Ham, Roscoe Conkling.....Kansas City, Mo.
Hinsch, VanBuren.....Davenport, Iowa
Holm, William Miller.....Chicago, Ill.
Hynes, Dibrell Pryor.....Ft. Smith, Ark.
Johnson, Horace Asabel.....Brookfield, Mo.
Kellogg, George Frederick.....Skidmore, Mo.
Lyneman, Felix Anthony.....Denver, Colo.
Mann, Horace Tharp.....Canon City, Colo.
Mix, Ward Barr.....Hailesboro, N. Y.
Mook, Robert Lee.....St. Louis, Mo.
Moore, Frederick Arnold.....Holden, Mo.
Murray, Edwin Phelps.....Lake City, Mich.
Neer, Don Morgan.....Winfield, Kan.
Nye, Alfred Leo.....Kearney, Neb.
Philippi, Paul Andrew.....St. Louis, Mo.
Radovich, John Christopher.....Bisbee, Ariz.
Sandford, John Joseph.....Dansville, N. Y.
Sedivy, Miles.....Cleveland, Ohio
Simington, Francis James.....Chicago, Ill.
Spofford, Howard Nelson.....Haverhill, Mass.
Smith, Harry Gilham.....Vinita, I. T.
Taggart, James Albert.....Freeport, Ill.
Thornhill, Edwin Bryant.....Gray Summit, Mo.
Walker, Leland Ross.....St. Louis, Mo.
Wood, Clyde Rex.....Sheridan, Wyo.
Worel, Lish.....Plattsmouth, Neb.

SOPHOMORES.

Baueris, William Albert.....Chicago, Ill.
Bowles, James Joseph.....Lake Springs, Mo.
Boose, Frank A.....Lincoln, Neb.
Chamberlain, Ernest Lorenzo.....Rolla, Mo.
Clarke, William Daniels.....Rolla, Mo.
Compton, James Crawford.....Independence, Mo.
Dobbins, Walter.....Champaign, Ill.
Don, DeForrest.....Rock Island, Ill.
Dosenbach, Benjamin Harrison.....St. Louis, Mo.
Dougherty, James Walter.....Cincinnati, Ohio
Dudley, Boyd, Jr.....Gallatin, Mo.
French, Charles Lewis.....St. Louis, Mo.
Garst, Harvey Oden.....Cabool, Mo.
Hall, William Simpson.....Pleasanton, Kan.
Holmes, Oliver Wendell.....Rolla, Mo.
Hughes, Frank Winnett.....Irondale, Mo.
Judy, Philip Smith.....Camp Point, Ill.
Kendrick, Robert Thomas.....East St. Louis, Ill.
Killian, Ralph Daniel.....Perryville, Mo.
Ladd, William Hammond.....Rolla, Mo.
Langsdale, Byron Withers.....Kansas City, Mo.
Leming, Paul Bauchmann.....Cape Girardeau, Mo.
Loveridge, Frank Richard.....Batavia, N. Y.

McCrae, Rowe Francis ..... Rolla, Mo.
McCutchen, William Lawrence ..... Wichita Falls, Tex.
Michael, Pearl Frederick ..... Rolla, Mo.
Morgan, Karl Rupert ..... Laurel, Miss.
Murphy, Benton Franklin ..... Bonne Terre, Mo.
Nachtman, Frank ..... Junction City, Kan.
Ohnsorg, Norman Lloyd ..... Rolla, Mo.
Olin, David ..... Kansas City, Mo.
Pfeiffer, John Baptist ..... Fullerton, Cal.
Pollard, Arthur Lewis ..... Batavia, N. Y.
Shah, Aaron Max ..... Vilma, Russia
Shaw, Albert Henry ..... St. Louis, Mo.
Stahl, William Glenroy ..... Little Rock, Ark.
Talwar, Fateh Chand ..... Gujranwala, India
Wander, Ernest ..... Chicago, Ill.
Watson, Ralph Wilhelm ..... Salt Lake City, Utah
Whitener, Oscar Miles Cornelius ..... Fredericktown, Mo.
Wishon, Azro Emory ..... Fresno, Cal.
Wolf, Edgar Joseph ..... Mt. Vernon, Ind.

FRESHMEN.

Allen, Robert Sexton ..... Kansas City, Mo.
Aycock, Robert Vaughn ..... Lebanon, Mo.
Beckner, Fred Goodrich ..... Salt Lake City, Utah
Bedford, Arthur Hardy ..... Aukland, New Zealand
Blake, Frank Orris, Jr. ..... Pittsburg, Penn.
Blaylock, Daniel Webster ..... Flat River, Mo.
Bryant, Albert Daly ..... Washington, D. C.
Bunten, James ..... Canon City, Colo.
Burdick, Charles Adrian ..... Dansville, N. Y.
Butcher, Jacob C ..... San Francisco, Cal.
Clark, John Charles ..... St. Louis, Mo.
Clark, William Newton ..... Jewell City, Kan.
Chew, Lindell ..... St. Louis, Mo.
Connelly, Harry Wade ..... Independence, Kan.
Detweiler, Alfred Nicks ..... Drynob, Mo.
Detweilier, Milan Harrison ..... Drynob, Mo.
Drake, Robert Lemon ..... Kansas City, Mo.
Dunn, Theodore Saunders ..... Waukegan, Ill.
Dye, Robert Emmet ..... Joplin, Mo.
Dykes, Guy ..... Rolla, Mo.
Diaz, Emilio ..... Santiago, Chile
Elicano, Victoriano ..... Masinloe, Zambales, P. I.
Elliott, Edward Arthur ..... Haileyville, I. T.
Elliott, Joseph Walter ..... Haileyville, I. T.
Farrar, Monroe ..... Mattoon, Ill.
Forman, John Kavanaugh ..... McFall, Mo.
Frazer, Keith Colt ..... Lyndonville, N. Y.
Gardner, Frank Beveridge ..... Staunton, Ill.
Gregory, Clay, Jr. ..... Joplin, Mo.
Goldman, Jay Maurice ..... St. Louis, Mo.
Gosrow, Ralfe Cleveland ..... Buffalo, N. Y.
Harris, Walter ..... Salt Lake City, Utah
Harrison, James Berry, Jr ..... Rolla, Mo.
Harrison, Walter Edward ..... Salem, Mo.

Humphrey, Brighton W. ..... St. Louis, Mo.
Hurwitz, Jacob Mordecai ..... St. Louis, Mo.
Insley, Earl Frank ..... Kansas City, Mo.
Jobes, Charles Taylor ..... Kansas City, Mo.
Jones, William Hamilton ..... St. Louis, Mo.
Karte, Anton ..... DeSoto, Mo.
*Killian, Alfred Robert ..... Perryville, Mo.
Lay, Beele Nathaniel ..... Denver, Colo.
Lembcke, Robert ..... Fargo, N. D.
List, Elmer ..... Cape Girardeau, Mo.
McDonnell, George Henry ..... Crown King, Ariz.
McNutt, Vachel Harry ..... Monroe City, Mo.
Mellor, Frederick ..... Liberal, Mo.
Miller, Christian R., Jr ..... Sedalia, Mo.
Minor, Harmon Edwin ..... Canon City, Colo.
Morgan, Allen Ray Dearborn ..... Rolla, Mo.
Morrison, Emory Lee ..... Auxvasse, Mo.
Nachtman, Ralph Collistus ..... Junction City, Kan.
Newton, Lloyd Charles ..... Gurdon, Ark.
Ormsby, Robert Graham ..... Kansas City, Mo.
Owen, Harvey Skidmore ..... St. Louis, Mo.
Park, Albert ..... Plattsburg, Mo.
Peeso, William D. ..... Junction City, Kan.
Phillips, Ralph Norman ..... Denver, Colo.
Pierce, Colwell Arba ..... Kansas City, Mo.
Porth, Harry William Lee ..... Kansas City, Mo.
Porri, Louis Joseph ..... St. Louis, Mo.
Riede, Frederick Edward ..... Canon City, Colo.
Roherer, Walter Elmer ..... South McAlester, I. T.
Seitz, Harold Moore ..... Kansas City, Mo.
Seltzer, Hymen Aaron ..... St. Louis, Mo.
Smith, Duncan Slater ..... Rockport, Ill.
Smith, Harvey Edson ..... St. Louis, Mo.
Smith, Van Hoose ..... Little Rock, Ark.
Stewart, John Sloane, Jr. ..... Mansfield, O.
Thornberry, Martin Harmon ..... Wanda, Mo.
Tomlinson, Edward Lorraine ..... Prescott, Ariz.
Townsend, Richard Henry ..... Aspen, Colo.
Traughber, Charles ..... Centralia, Mo.
Treuting, Frank Lewis ..... Bridgeport, Conn.
Trowbridge, Welles Edward ..... Springfield, Ill.
Twyman, George Thomas, Jr. ..... Independence, Mo.
Vogt, George C. ..... Davenport, Iowa
Vogt, John Gerhard, Jr. ..... Trenton, Ill.
Wiseman, Edward Wallace ..... Washington, D. C.

SPECIALS.

Elton, Thomas Bond ..... Webster Grove, Mo.
Esprui, Rafael ..... Mexico City, Mex.
Flood, Clarence Frank ..... Memphis, Tenn.
Garza, Andrea ..... Saltillo, Mexico
Garza, Antonio ..... Saltillo, Mexico
Guppy, Percy Lechmere ..... Trinidad, Port of Spain, W. I.
Hauser, Carl ..... Mt. Vernon, Iowa
Nichols, Charles Alexander ..... Pocohontas, I. T.

Palomares, Radolfo des ..... Mexico City, Mex.
Pierce, Roy Lawrence ..... Rolla, Mo.
Phillips, Logan Joseph ..... Brooklyn, N. Y.
Renfrow, Thomas O. ..... Rolla, Mo.
Richards, Louis Marquette ..... Colorado Springs, Colo
Shaffer, Thomas Patton ..... Rolla, Mo.
Valencia, Carlos, Jr. ..... Outlan Jalico, Mexico.

STATES.

Alaska	1
Arizona	3
Arkansas	4
California	4
Colorado	12
Connecticut	1
District of Columbia	2
Idaho	1
Illinois	17
Indiana	1
Indian Territory	5
Iowa	6
Kansas	11
Massachusetts	1
Michigan	1
Mississippi	1
Missouri	91
Nebraska	5
New Jersey	1
New Mexico	1
New York	10
North Dakota	2
Ohio	4
Pennsylvania	1
Tennessee	2
Texas	1
Utah	3
Wyoming	2
Total	194

FOREIGN COUNTRIES.

Chile	1
China	1
India	1
Japan	1
Mexico	6
New Zealand	1
Philippine Islands	1
Russia	2
Sweden	1
West Indies	1
Total	16

MISSOURI BY COUNTIES.

Barton	1
Boone	1
Callaway	1
Cape Girardeau	2
Chariton	1
Clinton	4
Davies	1
Dent	3
Franklin	2
Gentry	1
Jackson	14
Jasper	4
Jefferson	1
Linn	1
Laclede	1
Madison	1
Monroe	1
Newton	1
Nodaway	1
Perry	2
Pettis	2
Phelps	14
St. Francois	3
St. Louis City	22
St. Louis County	2
Texas	1
Washington	1
	91

INDEX.